

SECTION 4

ENVIRONMENTAL INVENTORY AND ANALYSIS

This Open Space and Recreation Plan represents a strategy for protecting open space while providing for recreation and allowing other compatible land uses within the ecosystem and will, if fully understood and implemented, help maintain our Town's quality of life. Trees, wildlife, and fisheries are its most visible tenants of the ecosystem after us, and a close careful survey of field and forest will show vast and complex biological interconnections among all species, true stakeholders in our collective commonwealth.

Protecting Wendell's Biodiversity

Using the Theory of Island Biogeography to Protect Wendell's Biodiversity

A large majority of Wendell's residents who responded to the open space questionnaire indicated that they wanted Wendell's biodiversity protected. The theory of island biogeography predicts that, all things being equal, biodiversity is greater on large islands than on small ones and greater on islands that are closer to the mainland. This has been extended to the notion of islands of protected open space surrounded by seas of development, with the conclusion that increasing the size of a protected area increases its biodiversity. This further suggests that connecting two already protected areas with a protected corridor, thus forming one large area from two smaller separated ones, will also increase natural biodiversity. The theory of island biogeography also suggests that biodiversity increases with proximity to other protected areas, so that nearby protected land is also valuable for this purpose. Saving Nature's Legacy, by R.F. Noss and A.Y. Cooperrider, provides a fuller discussion of this concept.

There is no clear agreement on how large protected areas should be to protect biodiversity except that they should be as large as possible. Similarly connective corridors should be as wide as possible. Obviously, stopping all further development would protect Wendell's biodiversity best, but that is clearly impossible. It is equally obvious that if all land available for development were developed, Wendell would be a much different place and its existing biodiversity would be seriously diminished. This suggests that more land should be permanently protected and the best way to do so would be to protect land connecting two pieces of already protected land, land adjoining already protected land, or land near already protected land.

Saving Nature's Legacy also describes the ideal notion of a biosphere reserve or bioreserve which consists of an unmanaged core area surrounded by a buffer in which light management such as long rotation forestry, hunting, fishing, and habitat manipulation for wildlife would occur. This would be surrounded by a further buffer area where more heavy management, such as low density housing and more intensive forestry, would occur, and surrounding all this would be urban and large scale agricultural land. This is further broadened into the idea of a regional bioreserve network where individual bioreserves are joined together by protected corridors.

The presence of an unmanaged core is important for a number of reasons. It provides a way of comparing the results obtained through management with the results obtained without management. It protects the habitat of species that need an undisturbed forest interior. It protects the habitat of sensitive species that require both wetlands and uplands, but that is not fully protected by the Wetlands Act.

Wendell has a good start at becoming part of such a regional bioserve network. The protected land in Wendell is already part of a protected corridor that almost connects the Connecticut River and the Quabbin Reservoir. The Whetstone Wood Wildlife Sanctuary (WWWS) acts as the unmanaged core area for this network.

Because of the existing pattern of development in Wendell, it is unlikely that the idealized regional bioserve network can be achieved. A more realistic potential model for Wendell open space planning from a landscape ecology perspective may be contained in the idea of "Aggregate with Outliers," which is described in Richard T. T. Forman's book, Land Mosaics. Such a landscape configuration would aggregate like uses while still allowing small bits of other uses. For example, farmland, built uses, and forest would constitute separate areas with limited residential development at forest edges, including small patches of habitat for flora and fauna within developed areas. Vegetated linkages in riparian corridors and between forest areas should be encouraged and maintained where they exist now. It is very important that roads not transect large blocks of forest otherwise free from interior development. Wendell already reflects this model by having large unfragmented blocks of protected forest and smaller patches of farmland with residential development aggregated along transportation corridors.

A More Scientific Approach Toward Protecting Wendell's Biodiversity

While the theory of Island Biogeography is still useful for protecting biodiversity, it is apparently controversial and a more scientific approach is preferred. Fortunately, shortly after the 2002 Open Space and Recreation Plan was published, the Natural Heritage and Endangered Species Program (NHESP) began to provide more scientific data. First came maps showing Biomap Core Habitat and Supporting Natural Landscape. Shortly thereafter they provided maps showing Living Waters Core Habitat and Critical Supporting Watershed, and still later they provided a map showing Large Blocks of Interior Forest Habitat. These maps are used in this Open Space and Recreation Plan and are described in more detail later (see the Large Blocks of Interior Forest Habitat shown on the Protected Open Space Map at the end of Section 5). Then, just as the present document was about to go to press, NHESP provided their latest maps showing Biomap2 Core Habitat and Critical Natural Landscapes. These two latest maps use large amounts of previously unavailable data and appear to combine all the features of the previous maps. In addition, Harvard Forest has made available state-wide maps showing the location of possible Primary Forest areas, using land use maps from the 1830s. (See the Biomap2 and Primary Forest Areas on the Environmental Habitat Map at the end of this section.) All of these maps will help Wendell prioritize land for protection purposes and they will also help the Planning Board make a better informed finding when implementing the new Conservation Development Bylaw (see page 3-35) approved at the Special town Meeting held on December 15, 2010.

In the interest of protecting biodiversity, it is very important that the large blocks of forest land remain as unfragmented by development as possible. Roads present a serious problem in this regard. A narrow road is less fragmenting than a wide one, a dirt road is less fragmenting than a paved one, a road with a full tree canopy is less fragmenting than one with little canopy; and roads with low traffic speed and volume are less fragmenting than those with higher speeds and volumes. If possible, road maintenance should take this into consideration, in particular where roads cross protected lands. In such areas dirt roads should not be paved or widened, paved roads should not be widened, and roadside trees should not be removed. This should apply to roads on protected lands as well. In addition, no new roads should be constructed through protected areas.

Wendell residents appreciate our natural, undeveloped environment—a driving force for many who settled here. By developing and using this Open Space and Recreation Plan as a decision-making tool, we seek to balance our needs for land, resources, and infrastructure with the requirements, finite limits and beauty of the ecosystem.

Ecosystems consist of the populations of living creatures together with the nonliving parts of the environment and they are variable in scale: an entire forest, or a single tree within it. Ecosystems are dynamic; they operate and function as wholes, providing the necessities for survival for all their populations, including human beings. Wendell residents understand that the ecosystem is easily damaged, and that certain land uses have negative impacts on the integrity of the ecology and therefore the quality of human life.

Overview of Section 4

The information provided in this section, Environmental Inventory and Analysis, inventories the quantity and quality of the natural resources contained within Wendell. The subsection on *Topography, Geology, and Soils* provides a foundation for understanding the ways different soil characteristics can impact land use values. *Landscape Character* provides a gross scenic context within which the resources play important roles. The *Water Resources* section describes all of the water bodies in Town, above and below ground, including their recreational value, public access, and any current or potential quality or quantity issues. Wendell's forest, farmland and wetland vegetation types are documented in the *Vegetation* section including rare, threatened, and endangered species. In the *Fisheries & Wildlife* section, wildlife, their habitats, special corridors, and rare, threatened, and endangered species are discussed. The *Scenic Resources and Unique Environments* section identifies and maps those areas in Wendell that contribute to the community's character. These include scenic landscapes; major characteristic and geological features; cultural, archeological and historic areas; and unique environments. The *Environmental Challenges* section discusses issues in Wendell and our region that influence open space and recreation planning, including hazardous waste and brownfield sites, landfills, erosion, chronic flooding, sedimentation, new development, pollution of ground and surface water, and impaired water bodies.

A. TOPOGRAPHY, GEOLOGY, AND SOILS

A.1 Topography

Mountain peaks, steep ledges, occasional deep ravines, rushing streams and wetland pockets characterize the topography of Wendell. The Town can be divided into two topographic regions. The northern half of Wendell is more rugged and is characterized by interconnected till-covered hills with steep-walled narrow valleys. The highest point of this northern half is the crest of Bear Mountain with an altitude of 1,274 feet. The lowest point, along the Millers River (at the mouth of Lyons Brook) has an altitude of approximately 292 feet. The remaining prominent peaks located in the northern rim include Bullard Hill in northeast Wendell with an elevation of 1,187 feet and Jerusalem Hill in the northwest corner of Wendell with an elevation of 982 feet.

Wendell Center sits high on a drumlin that runs north-south along Depot Road and Lockes Village Road to Locks Hill. The drumlin has a total length of about 10,000 feet and an average width of 3,000 feet and elevation of about 1,164 feet. A number of small to moderate sized tracts of wetland are situated in all of these uplands particularly near Wendell Center.

In contrast, the southern half of the Town is less rugged and is characterized by isolated till-covered hills with gently sloping valley walls and broad valleys. Orcutt Hill, elevation 1,306 feet, is the highest point in Wendell. The lowest point in this southern section of Town, along the West Branch-Swift River, is 818 feet.

Steep slopes that are over 25 percent grade (hills that rise one foot for every four horizontal feet) occur in various parts of Wendell and are considered constrained for development purposes. Slopes of 15 to 25 percent grade are located in the northern section of Wendell as well as running along the eastern and southeastern borders. While Wendell's terrain is varied with its changing grades providing interest and diversity in the Town, the great majority of Wendell is at a grade of 15 percent slope or less.

A.2 Geology

The sources for the following subsection include A Hydrogeologic Investigation of Wendell, Massachusetts by T. Limbers (1994), the 1987 Wendell Open Space Plan, and a 1996 University of Massachusetts graduate student report on the region's geological history. Limbers (1994) noted that there are two principal geologic units in the Town of Wendell. These are the bedrock formations exposed in the hilly areas of the Town and the unconsolidated surficial deposits that generally occur in the valley regions of Wendell.

The Town of Wendell that we recognize today is the result of millions of years of geologic history: the great upheavals of the earth's crust and volcanoes, and the sculpting power of moving water, ice, and wind. This distinctive physical base has determined the distribution of the Town's water bodies, its soils and vegetation, and its settlement patterns, both prior to and since colonial settlement.

A.2.1 Geological History

The following text describes the region's geological history over the past 700 million years.

Mountain Building: 700 Million Years to 190 Million Years Ago

The earth's crust is actually a system of plates whose movements and collisions shape the surface. As the plates collide, the earth's crust is compressed and forced upward to form great mountain ranges. In the northeastern United States, the plates move in an east-west direction, and thus the mountains formed by their collisions run north to south. Both the Taconic Mountains and the Appalachians were formed in this way.

The pressure of mountain building folded the earth, created faults, and produced the layers of metamorphosed rock typically found in New England today. Collision stress also melted large areas of rock, which cooled and hardened into the igneous rocks that are found in some of the hill towns in Massachusetts. Preceding the collisions, lines of volcanoes sometimes formed, and Franklin County shows evidence of this in bands of dark schist rock metamorphosed from lava flows and volcanic ash.

Earthquakes and Dinosaurs: 190 Million to 65 Million Years Ago

During the Mesozoic Age, a great continent known as Pangaea formed through the plate collisions. Pangaea began to break apart almost 200 million years ago (and continues today). This caused earthquakes and formed large rift valleys, the largest of which became the Atlantic Ocean. The Connecticut Valley was one of many smaller rifts to develop, and streams flowing into it from higher eastern areas brought alluvium including gravels, sand and silt. The footprints of dinosaurs are still visible in the sedimentary rock formed from these materials on the valley floor.

By the close of the Mesozoic Age, the entire eastern United States was part of a large featureless plain, known as the peneplain. It had been leveled through erosion with the exception of a few higher, resistant areas. Today, these granite mountaintops, named monadnocks, are still the high points in this region. Local examples include Mt. Monadnock in New Hampshire; Mt. Wachusett, and Mt. Grace are other nearby examples.

As the peneplain eroded, the less resistant rock eroded to form low-lying areas, while bands of schist remained to form upland ridges. By this time, the Connecticut Valley had been filled with sediment, while streams that would become the Westfield, Deerfield, and Farmington Rivers continued to meander eastward. The Miller's River and other westward-flowing streams would become more prominent later on.

Cenozoic Era and the Ice Age, to the Present: 65 Million Years Ago to Today

A long period of relative quiet followed the Mesozoic era. Then, as the Rocky Mountains were forming in the west eight million years ago, the eastern peneplain shifted upward a thousand feet. As a result of the new steep topography, stream flow accelerated, carving deep valleys into the plain. The plain rose one more time, and the Millers River, once a slowly meandering westward flowing stream, now carved its course through the sediment and bedrock. Today, the visible

remnants of the peneplain are actually the area's schist-bearing hilltops, all at about the same 1,000 foot elevation.

Mountain building, flowing water, and wind had roughly shaped the land; now, the great glacial advances would shape the remaining peneplain into its current topography. The earth's climate cooled until a point about two million years ago when accumulated snow and ice in the far north began advancing under its own weight. A series of glaciations followed, eroding mountains and displacing huge amounts of rock and sediment. The final advance, known as the Wisconsin Glacial Period, completely covered New England before it began to recede about 13,000 years ago. It scoured and polished the land into its present form, leaving a layer of glacial debris and landforms that are still distinguishable.

While the Miller's River probably first formed prior to the glacial period, most of Wendell's hydrological system is a remnant of that time. The major streams follow a north-south course with the topography. Smaller streams flow from uplands feeding the extensive wetlands formed by sedimentation that filled drainage points when the glacier receded.

The glacier left gravel and sand deposits in the lowlands and along stream terraces. These are the present day locations of the Miller's River. Where deposits were left along hillsides, they formed kame terraces and eskers. Kames are short hills, ridges, or mounds and eskers are long narrow ridges or mounds of sand, gravel, and boulders that followed streams flowing under the ice. Both are formed by glacial melt waters.

A.2.2 Bedrock Geology

Most features of the Town of Wendell's geology are oriented north-south with the exception of the Millers River that cuts its way west through miles of gneissic rock. The subsurface geology took its present shape during the Acadian orogeny, a period of mountain-building, beginning 390-400 million years ago. An orogeny is a process of mountain formation which folds the earth's crust. Pulses of deformation variously contorted the rock layers of Jerusalem Hill and Bear Mountain, both part of the Pelham Dome in Wendell. Just east of the dome lies the northern tip of the Pelham-Shutesbury Syncline, which extends southward into Shutesbury, passing through Locks Hill and emerging as a ledge across the roadbed, just south of the crest. A syncline is a trough of stratified rock. East of Wendell Center and west of Wendell Depot and Orcutt Hill is the Wendell Syncline, which is found near the Warwick Dome and the Kempfield Anticline and proceeds south into Shutesbury. An anticline is an arch of stratified rock where the layers bend downward in opposite directions from the crest. Further east is the Kempfield Anticline, that extends from a point north of the Millers River through Wendell Depot, Bullard Hill, Orcutt Hill and southward into Shutesbury. Along the eastern edge are found outcrops of Clough quartzite of lower Silurian age along with gray micaceous schist and thin strata of garnet schist. The Silurian age is a period of the Paleozoic era that marked the beginning of coral reef formation and the appearance of crustaceans. Between the Kempfield Anticline and the main body of Monson Gneiss in Orange lies the Prescott complex, a pluton and syncline. A pluton is a large body of intrusive igneous rock that formed from cooling magma. Schistic rock may also be found near the New Salem line in the southeast corner of Wendell.

According to Limbers (1994), the bedrock formations consist of metamorphic and igneous crystalline rocks with low water-bearing potential except where highly fractured. The geologic units underlying the Town may be divided into two categories, the consolidated deposits of Precambrian to Devonian age and the unconsolidated deposits of Pleistocene and Holocene age. Because of low primary and overall homogeneous porosities of the bedrock formations, Limbers describes the bedrock of Wendell as a single geologic unit with respect to groundwater occurrence. This unit is described as bedrock formations consisting of metamorphosed sedimentary and intrusive and extrusive igneous rocks of Precambrian to Devonian age. The bedrock formations are part of the Pelham Dome. The apex of the dome is elongated in a northerly direction; its layers dip outward in all directions. In the Wendell area, foliation of the units dips eastward at angles less than five degrees. In the eastern half of the Town, the bedrock is predominantly Ordovician Four-mile Gneiss consisting of gray, massive to moderately layered, well-foliated biotite gneiss containing beds of hornblende-epidote amphibolite. In the western half, the Late Proterozoic Dry Hill Gneiss is predominant, consisting of gray to pink, coarse grained, granite gneiss with biotite and hornblende-rich members. In general, the older units of the Pelham dome crop out near its apex in the western half of Wendell, whereas the younger units crop out with increased distance from the apex in the eastern half. On a larger scale, the rock units are part of the Bronson Hill Anticlinorium approximately three miles east of the Connecticut Valley Border Fault.

A.2.3 Surficial Geology

Surficial geology includes locations of deposits of glacial till, areas of sand and gravel, lake bottoms and other surface features. The retreat of the glaciers following the most recent ice age blocked the flow of water northward toward the Millers River and water flowed southward in the valleys containing both the Whetstone and Osgood Brooks. This resulted in the accumulation of large gravel deposits in these valleys that now are likely aquifer sites. Numerous features of glacial activity are found throughout Wendell, including sand deposits, eskers, (ridges deposited by rivers under the ice) and kettle hole ponds (depressions formed by blocks of ice left behind by glaciers).

These unconsolidated deposits are: 1) upper and lower till, which are heterogeneous mixtures of clay, silt, sand, and cobble to boulder sized gravel with low to moderate hydraulic conductivity commonly covering the hilly areas, 2) stratified drift, consisting primarily of fluvially (produced by stream action) and glaciofluvially (produced by streams from glaciers) derived sands and gravels with moderate to high hydraulic conductivities, which serve as a storage reservoir for precipitation and an easy passage for recharge to underlying permeable deposits and fractured bedrock and 3) swamp and lacustrine (formed in lakes) deposits, which have high hydraulic conductivity but are undesirable as aquifers because of insufficient thickness. Limbers noted that only the stratified drift has the necessary transmissivity and thickness to provide potential municipal water supplies. These specific areas may offer Wendell opportunities for developing municipal water sources (See Water Resources on page 4-12).

A.3 Soils

Soil is the layer of minerals and organic material that covers the rock of the earth's crust. All soils have characteristics that make them more or less appropriate for different land uses. Scientists classify soils by these characteristics, including topography; physical properties including soil structure, particle size, stoniness and depth of bedrock; drainage or permeability to water; depth to the water table and susceptibility to flooding; behavior or engineering properties, and biological characteristics such as presence of organic matter and fertility (University of Massachusetts Cooperative Extension; 1976). Soils are classified and grouped into associations that are commonly found together. These soil associations are named for the dominant or prevalent soils they contain.

As Wendell plans for the long-term use of its land, certain soil related questions arise:

- 1) Which soils are best for agriculture?
- 2) Which soils and substrate impact current and future drinking water supplies?
- 3) Which soils constrain development given current technologies?
- 4) Which soils support recreational opportunities and wildlife habitat?

The answers to these questions can help lay a foundation for open space and recreation planning in Wendell.

A.3.1 Soils for Agriculture

One good way for determining whether the Town contains soils suitable for different developed uses is to identify current farmland as well as those developed lands that used to be farm fields. Unlike the communities in the Connecticut River Valley, Wendell's soils are not deep, well-drained sandy loams. Those Valley soils are good for farming because they contain and hold nutrients and moisture in a manner supportive of growing plants. These soils are also very good for development and recreational field use because they are often level, deep, and supportive of in-ground septic and drainage systems. A good soil for septic systems will filter released wastewater in a manner that protects groundwater quality. Soils that are too wet will not allow wastewater to move or be filtered by the natural decomposition processes that occur in these soil layers. On the other hand soils that are too porous cannot hold wastewater long enough to be naturally filtered and purified by organisms in the soil, allowing untreated septage to move into the groundwater. Prime farmland soils often have the best characteristics for both farming and residential development.

The Town of Wendell has 1,416 acres or 6.3 percent of its land that can be classified as prime farmland.¹ Only a portion of this (1.25 percent) is actively used as pasture, tilled or otherwise productive agricultural land. These prime farm soils include Agawam and Gloucester types. These soils are scattered throughout the Town in pockets of five to 100 acres. However, there

¹ Prime farmland, as a designation assigned by U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses.

are larger blocks located in the center of the Town and in two north-south bands to the east of the Town Center.

Prime farmland soils support farming that contributes to Wendell's rural character and its economy. These farms provide residents local employment opportunities and maintain the Town's rural character. They also provide visual relief from the dense wooded areas dominating the region. Because these farm soils are the best kinds for agriculture and also the most likely type to be developed, Wendell residents may want to prioritize these areas in their land conservation efforts.

According to the Prime Farmland and Development Restraints Map (at the end of this section), prime farmland soils occur predominantly in the southern half of Wendell along streams and roadways. The three largest aggregates of these prime farmland soils are in north-south bands along Wendell Depot Road, bisecting Morse Village Road, and straddling Cooleyville Road. There are also clumps of these soils near Sibley Swamp, near the New Salem town line off Morse Village Road, at the intersection of Plain and New Salem Roads, along West Street, and just south of Fiske and MacAvoy's Ponds. In many cases, prime farmland soils overlie aquifers, are already farmed, or are already developed.

A.3.2 Soils that Impact Drinking Water Supplies

Soils of the Hinckley and Gloucester associations generally have high filtration rates and low runoff potential. The more easily drained Hinckley association forms in valleys on stratified drift. The Gloucester association, covering more than 50 percent of Wendell, forms on gently sloping and steep upland areas on sandy till. Both of these associations provide high amounts of recharge to aquifers in Town.

Rapidly draining soils are sometimes also poor filtering soils and include Agawam, Carver, Gloucester, Hinckley, Merrimack, and Windsor soils. These are found in the more easily developed areas. These soils provide little filtration to septic leachate as water passes through these soils very quickly, which may not be a problem when the depth to ground water is great. Unfortunately, aquifers are usually found where these soil types are located. Development could potentially pollute these aquifers if care is not taken to protect them.

A.3.3. Soils that Constrain Development

Steep slopes and wet soils prohibit and limit development on a significant portion of Wendell's land. Slopes over 25 percent, soils with a seasonal high water table less than one and one-half feet below the surface of the ground, identified wetlands, and lands already built upon are located primarily in the northwest third of Town. There are smaller blocks along the eastern town line and along a northeast-southwest strip in the southern half of the Town. This configuration follows in large part the layout of conservation lands in the Town, the single most significant factor currently prohibiting development in the Town of Wendell.

Those areas limited by a seasonal high water table one and one half to three feet below the surface, slopes of 15 to 25 percent, or bedrock ten to twenty inches below the surface are

uniformly distributed throughout the remainder of the Town and comprise approximately 5,400 acres. While buildable, the constraints to development may be moderate to severe in these areas due to the difficulty in sustaining adequate percolation for septic fields, limiting the number of housing areas possible.

The most easily developed land—only 11 percent of Town—is scattered throughout the central and southern portions of Wendell, following roughly the same course as the existing development. These least-constrained lands are in pockets of ten to 150 contiguous acres. Approximately three quarters of these parcels are located on existing roads, which could provide access to building sites.

A.3.4. Soils that Support Recreational Opportunities and Wildlife Habitat

Different recreational uses are constrained by separate soil and topographical characteristics. Sports fields require well-drained and level soils. Lands with slopes over 25 percent may be attractive to mountain biking and hiking enthusiasts but should be so used only if the soils are not easily eroded. Erodable soils include those that are shallow, wet, sandy, or sloped or those with a combination of these characteristics.

As Wendell continues to experience development pressures, those soils that may best support a variety of wildlife habitats may prove to be those that provide the most constraints to development. Wendell might consider identifying and protecting areas surrounding hydric or very wet soils. More than likely, these soils would provide a diverse array of species habitats. In addition, protecting any remaining high slope areas along ridge tops would also provide for the protection of habitats for large mammals as well as scenic views.

A.4 Analysis

A discussion of topography, geology, and soils in an open space and recreation plan helps to clarify what makes Wendell special. Overall, a discussion of open space and recreation planning will always revolve around human use of the land, development, and the impacts of that development on the systems that are at the base: soil nutrients, water purity, biodiversity, etc. The bedrock may be moving, but humans tend to change the landscape at a much faster rate. Which soil, geologic, and topographical characteristics should be considered when planning for open space and recreation resources? Wendell residents may want to develop a conservation plan to protect remaining prime farmland soils for future food production. Potential aquifers are vulnerable to contamination from surrounding septic systems and land uses and these may just be the Town's future drinking water supplies. Residents may also want to determine the recharge areas for these aquifers towards ensuring their long-term protection from contamination.

Overlaying the outlines of aquifers onto the Soils and Geographic Features Map uncovers relationships between land use, ownership, and the ecosystem processes that support life. Wendell residents are very fortunate to have so much land protected. There is a possibility that by protecting a few key parcels of land an important aquifer may be protected from developed uses. On the other hand, many areas that contain prime farmland soils occur atop aquifers. The

Town may want to ensure that anyone farming these lands is using agricultural best management practices or perhaps organic management practices.

B. LANDSCAPE CHARACTER

The Town of Wendell derives its special character as much from its landscape as from its people and their sense of community. The Town of Wendell has a rugged landscape with large tracts of undeveloped forest lands, abundant wetlands and streams, and a sparsely settled but changing rural residential landscape. The woodlands of Wendell State Forest and Whetstone Wood Wildlife Sanctuary provide the residents of Wendell, and the surrounding communities, with large tracts of protected open space. As well as these protected lands, residents of Wendell perceive three relatively small and widely spaced distinct villages: the Depot, Mormon Hollow and the Town Center. The Town Common and its surrounding buildings, including Town Hall and the Library, are located near the geographic center of Wendell. This is considered the community's focal point and is widely viewed as being prominent in the collective image of the Town. The Common and the surrounding farms also contribute to the sense of open space in this central location. Three establishments on the Common—the Country Store, the Post Office and the Deja Brew—are central to daily life in Wendell and are valued, important sites in Town.

A drive through Wendell takes one down the many narrow winding dirt roads, one of the Town's most prominent features. One is struck by the almost continuous densely wooded hillsides lining both sides of the road. Occasionally, a rare open field and farmstead offers an opportunity for a somewhat more distant view and relief from the dense canopy of trees. Many old paths, trails and unmarked, un-maintained roads as well as wetlands and streams are also noted along the roadsides. Most homes in Wendell are built close to the road, although a number are hidden from view with only a dirt driveway making them evident to the passerby. The overall visual impression when traveling through Wendell is one of space, wildlife, nature, privacy, peacefulness, and community.

Development, whether residential or commercial, has a distinct impact on the rural character of the Town as well as its natural environment. The protection of the existing open landscapes including farms with fields that provide open space and views, particularly around the Town Common, is especially important as a contrast to the wooded nature of the remaining areas of town. Protection of roadside wetlands, woodlands and stonewalls would help ensure the retention of the sense of space and character of the town. Long-term management of state lands and Town wetlands/ponds, with active input from residents and the Lake Wyola Advisory Committee (which also deals with issues related to the Wendell State Forest), is necessary for continued environmental protection, public access, and enjoyment for residents of Wendell and the surrounding communities.

C. WATER RESOURCES

Water resources for the Town of Wendell are shown on the Water Resources Map at the end of this section.

C.1 Watersheds

Wendell is part of three river basins – the Millers River watershed to the north, the Chicopee River (Quabbin) watershed to the southeast, and the Connecticut River watershed to the southwest. The Connecticut River watershed is the largest river ecosystem in New England. It contains 38 major tributaries/sub-watersheds including the Millers and Chicopee Rivers. The Connecticut River watershed encompasses approximately 11,000 square miles and travels from its headwaters at Fourth Connecticut Lake at the Canadian border and through four New England states: Vermont, New Hampshire, Massachusetts and Connecticut. The River enters Massachusetts at the Town of Northfield and drains all or part of forty-five municipalities in the Commonwealth before entering the State of Connecticut where it eventually empties into Long Island Sound at Old Saybrook. The watershed is 80 percent forested, 12 percent agricultural, 3 percent developed and 5 percent wetlands and water.²

In 1998, President Clinton designated the Connecticut River an American Heritage River, one of only fourteen in the Nation. As an American Heritage River, the Connecticut can receive special attention from federal agencies for the cultural, economic and environmental values of the river. Also, in 1991, the entire Connecticut River watershed was designated the Silvio O. Conte National Fish and Wildlife Refuge by an act of Congress. The Conte Refuge is the first of its kind, encompassing an entire watershed ecosystem in four states; it is a benchmark in environmental conservation.

The northern two thirds of Wendell is located in the western portion of the Millers River watershed, which includes portions of seventeen communities in north central Massachusetts and four towns in southwestern New Hampshire. It is bordered on the east by the Nashua River watershed, on the north by the Ashuelot River watershed and on the south by the Chicopee River watershed.

The Chicopee River watershed is comprised of four river basins, including the Swift River, which drains into the Quabbin Reservoir. Nineteen percent of the Town of Wendell drains into the Quabbin Reservoir via tributaries of the Swift River, which include the West Branch of the Swift River, Sibley Swamp, and the Middle Branch of the Swift River, all located in the southeastern section of Wendell. The southwestern section of Wendell drains to the Connecticut River via the Sawmill River and its tributaries – Skerry, Plympton, Fiske, and Red Brooks. The Sawmill River flows southwest through the Towns of Shutesbury, Leverett, and Montague to its confluence with the Connecticut River.

² The 1994 Environmental Impact Statement for the Silvio O. Conte National Fish and Wildlife Refuge.

C.2 Surface Water

The Town of Wendell has approximately 180 acres of open water, according to MassGIS 2005 land use data. The Millers River, a large river of statewide importance and historical significance, borders the Town on the north for seven miles. There are six ponds with over three acres in surface area in the Town of Wendell. Bowens, MacAvoy's, Ruggles, Wickett, Fiske and Stillwater Ponds, in total, cover an area of 84 acres. In addition to the above ponds, Wendell has many small bodies of water ranging in size from one-eighth to three acres. These small ponds are used for fire protection and private recreation. Numerous small streams can also be found throughout Town. These have small sub-watersheds and generally high velocities, consequences of Wendell's steep terrain.

The following inventory describes Wendell's rivers, streams, brooks, and ponds focusing on the extent of public access and recreational value as well as any water quality issues. The 2010 Massachusetts Integrated List of Waters (Section 303(d)), prepared by Department of Environmental Protection (DEP), is used as a source document for the Millers River and all listed surface waters within the Town of Wendell including Ruggles and Bowens Ponds. Section 303(d) is part of the Federal Clean Water Act. The State is required by the United States Environmental Protection Agency to identify water bodies that are not expected to meet surface water quality standards after the implementation of technology-based controls. In each case, the most severe pollutant is identified. Although the affected water bodies may contain other pollutants, the 303(d) list includes the results of only those evaluations upon which DEP has exercised some measure of quality control. The Integrated List of Waters lists water bodies according to the following five categories:

- 1) Unimpaired and not threatened for all designated uses;
- 2) Unimpaired for some uses and not assessed for others;
- 3) Insufficient information to make assessments for any uses;
- 4) Impaired or threatened for one or more uses, but not requiring the calculation of a Total Maximum Daily Load (TMDL); or
- 5) Impaired or threatened for one or more uses and requiring a TMDL. Waters listed in Category 5 constitute the 303(d) List and, as such, are to be reviewed and approved by the EPA.

C.2.1 Millers River

From its tributaries of origin in New Hampshire, the Millers River flows south, then gradually west, ultimately flowing into the Connecticut River. The Millers River drains a regional landscape of 392 square miles in size, 320 of which are in Massachusetts (Massachusetts Department of Environmental Protection; 1995). The total river length is fifty-one miles, forty-four of which are in Massachusetts. Although the Millers River fluctuates between sluggish and rapid flows, there is an average drop of twenty-two feet per mile. This feature made the Millers River and its main tributaries a magnet for manufacturing and hydroelectric power generation, providing the impetus for industrial activities in neighboring towns in the late 1700's.

Residents of the region value the Millers River for its recreational and natural resource values. Seven miles of the Millers River flows through Wendell along its northern border, providing opportunities for fishing, wildlife and scenic viewing, whitewater boating and hiking. However, public access to the Millers River in Wendell is limited. Potential access is available at the end of Sears Road. The only put-ins for canoeists and kayakers in Wendell are located at the Farley Bridge and Wendell Depot. According to the Massachusetts Division of Fish and Wildlife (DFW), land along the Millers River in Wendell is considered to have exemplary or unusual examples of natural communities including good examples of floodplain forests and high-energy riverbank communities. Also, the Millers River and its tributary Whetstone Brook support a variety of species including freshwater mussels. Freshwater mussels are particularly good indicators of water quality and therefore their presence may indicate improving conditions along the Millers River.

The quality of the water in the Millers River is important for many reasons. Clean water supports life in all of its forms and is reason enough to keep the river environment healthy. Other people may be motivated by the desire to swim or fish in the river. Currently, the Millers does not meet Class B fishable/swimmable status. The stated class for a particular river is in fact only the State's goal for that river. Hence there are public health warnings against eating native fish species caught in the Millers River. It also implies that the future recreational potential for the Millers River may in part depend on continued water quality improvements.

Regulation of industrial discharges under the Clean Water Act beginning in the early 1970s and advocacy by the Millers River Watershed Council (MRWC) resulted in substantial improvements in water quality in the Millers River. In 1983 the Millers River was stocked with fish for the first time in 20 years. Along with the regular sport fish, 20,000 juvenile salmon were released as part of the salmon restoration program. The Millers River no longer smelled or looked dirty, but fishing is on a catch-and-release basis only (Showers, 2000).

The continued presence of dangerous levels of mercury and PCBs buried in sediments has prevented the Millers from achieving its classification as "swimmable and fishable." Fish in the river have been found to contain these chemicals at levels resulting in public health warnings prohibiting their consumption. The full extent of PCB contamination of the sediments is under continued study by the DEP. The contamination undoubtedly has a negative long-term impact on the recreational potential of the Millers River for the Town of Wendell and surrounding communities.

Continuing support for the PCB study currently being done by the U.S. Geological Survey is one of the state's top five priorities for the Millers River Watershed. Other priorities include performing a hydrologic assessment and water supply forecast to identify flow and yields throughout the watershed and sub-watersheds; developing a non-point source assessment to comprehensively assess both existing and potential sources of water quality problems; and developing and implementing a water quality sampling program to characterize the current condition of the watershed.

In 2001, the Millers River Watershed Team also began implementing a Strategic Monitoring and Assessment for River Basin Teams (SMART) monitoring program in conjunction with the Department of Environmental Protection, the Division of Watershed Management and the Wall

Experiment Station. This program provides important information on long-term on-going water quality trends in the watershed. Volunteer monitoring teams were formed to collect data and information in the watershed.

C.2.2 Other Rivers and Brooks

- West Branch Swift River
Wendell contains the headwaters of the West Branch of the Swift River which flows into the Quabbin Reservoir. The West Branch starts east of Wendell Center and flows out of Town in the southeast corner. Several beaver ponds along its length serve as excellent wildlife habitat. Approximately one and a half (1.5) miles of the stream are within Wendell State Forest. At the southern boundary of town, the stream borders land owned by the Department of Conservation and Recreation (DCR). The remainder passes through private land. Residents of Wendell enjoy fishing along its banks.
- Middle Branch of the Swift River
The Middle Branch of the Swift River also has its headwaters in Wendell. The river begins along the southwest slopes of Poor Farm Hill in the southeastern corner of Wendell. The peak of Poor Farm Hill is in New Salem near the Wendell/New Salem Town Line.
- Whetstone Brook
Whetstone Brook begins east of New Salem Road and flows for approximately five miles north into the Millers River near Wendell Depot. The brook is especially scenic and flows through the Wendell State Forest and the Whetstone Wood Wildlife Sanctuary for most of its length. Its remoteness, numerous wetlands, and beaver ponds make the area surrounding Whetstone Brook superb wildlife habitat. The brook had a reputation as a fine trout stream but has suffered from acidification. The undeveloped watershed and effects of acid rain contributed to making Whetstone Brook one of three sites in the United States chosen for a federal study of methods to reduce acid rain damage to streams. Whetstone Brook is listed in 2010 Integrated List of Waters as a Category 5 water body for “priority organics.”
- Mormon Hollow Brook
Mormon Hollow Brook starts at Wickett Pond in the Wendell State Forest and flows parallel to Lyons Brook owned by the Division of Fisheries and Wildlife. This brook has provided good fishing and is easily accessed from Farley Road. All except the last three-quarter miles of the brook lie within the Wendell State Forest. Wendell residents enjoy swimming and fishing at Mormon Hollow Brook. Mormon Hollow Brook is listed in 2010 Integrated List of Waters as a Category 5 water body for “priority organics.”
- Osgood Brook
Osgood Brook begins in the swamplands, which lie in the valley between New Salem, Wendell Depot, Morse Village and Plain Roads. It flows from this area to the westerly side of Wendell Depot Road and then to Bowens Pond. From there it crosses to the easterly side of Wendell Depot Road, which it then parallels for most of its course to the Millers River. The stream provides fishing and scenic views along Depot Road. Approximately two-thirds

of the stream's length is east of Depot Road in the Wendell State Forest. Much of the headwaters of the brook are contained in the Whetstone Wood Wildlife Sanctuary.

- Lyons Brook
Lyons Brook begins at Ruggles Pond and flows approximately two miles to the Millers River, forming a portion of the boundary between Wendell and Montague. About three-quarters of a mile of Lyons Brook lies within the Wendell State Forest. The remainder flows through private land. Lyons Brook is listed in 2010 Integrated List of Waters as a Category 5 water body for “priority organics.”
- Plympton Brook
Plympton Brook originates west of Wendell Center and flows south to Lake Wyola in Shutesbury. It has been impounded at several points forming Stillwater Ponds and McAvoy’s Pond. The headwaters of Plympton Brook are on the Division of Fisheries and Wildlife land but the brook below Stillwaters Pond lies entirely on private lands.

C.2.3 Ponds

- Ruggles Pond
Located entirely within Wendell State Forest, Ruggles Pond is open to the general public for swimming and fishing. This pond is bordered by a scenic shrub swamp and marsh providing excellent habitat for wildlife including migrating waterfowl. The Ruggles Pond area is surrounded by woodlands and is very scenic. The pond is considered by residents to be a valuable recreational resource particularly for bird watching, canoeing, boating, picnicking, and swimming. Ruggles Pond was listed on the 1998 Massachusetts Section 303(d) List of Waters due to noxious aquatic plants. Noxious plants impair water quality when native and non-native species are present in such a quantity that it retards other uses for the body of water. Today, Ruggles Pond is listed in the 2010 Integrated List of Waters as a Category 2: “Attaining some uses; other uses not assessed.”
- Wickett Pond
Also lying within the Wendell State Forest, Wickett Pond offers ice skating, hiking, fishing, canoeing, boating, and bird watching to the public, in a solitary woodland setting. There is excellent wildlife habitat in the surrounding woodlands and pond edge.
- Bowens Pond
Located off Depot Road, Bowens Pond is surrounded by woods and fields and offers scenic views from the road. Privately owned, this pond is used by residents for fishing.
- Fiske Pond
Located off West Road in the southwesterly portion of Town, Fiske Pond is fed by Fiske Brook and drains into Tyler Pond and then into Lake Wyola in Shutesbury. This is a special ecosystem featuring, at the same site, plant species from ecological communities as disparate as the Atlantic Coastal Plain and the prairies of the Midwest. Paul Godfrey is a retired professor of botany at UMASS and Wendell’s resident expert on this unique area.

For many years Fiske Pond was enjoyed by Town residents as a swimming hole while the 125 acre property was privately owned. In 2005, the Town purchased the property with help of a state grant and established the Fiske Pond Conservation Area. With help from the Fiske Pond Advisory Committee, local volunteers and funds raised by the Mount Grace Land Conservation Trust, the Conservation Commission has taken actions to protect the property such as restricting parking and vehicular access by gating access roads, removing trees and brush from the dam, removing invasive species, installing a beaver deceiver, and posting the property. The Loop Trail surrounding the pond has been cleared and marked as have connecting trails leading to the M&M Trail. Efforts to bridge wet spots to protect the places from pedestrian damage are underway. Other improvements include a new parking lot with an information kiosk, wooden trail signs, several bluebird boxes, and a duck box.

- McAvoy's Pond
Located at the south end of Town, McAvoy's Pond provides habitat for amphibian, fish, waterfowl, wading and predatory birds, as well as various mammals, including beaver, otter, and deer, and provides water storage. The pond is on private land.
- Stillwater Ponds
These ponds, created by small dams along Lockes Village Road, provide wildlife habitat and water storage. They are privately owned. Stillwater Ponds are suitable for fishing, skating, and boating, and provide scenic views from Lockes Village Road.
- Other Small Ponds
Wendell contains several small ponds of several acres that are valuable for wildlife habitat, recreation, and water storage. Most are located on private land. Included in this category are the Twin Ponds on both sides of Jennison Road near the New Salem town line, Tyler Pond just downstream of McAvoy's Pond, Sibley Swamp Pond and beaver ponds along the West and Middle branches of the Swift River, Whetstone Brook and in the Plain Road Swamp.

C.3 Wetlands

The Town of Wendell contains several large forested wetlands and dozens of smaller forested, shrub and emergent marsh wetlands. A very large number of smaller, unmapped wetlands falling under the jurisdiction of the Wetlands Protection Act and the Town of Wendell's Wetland Bylaws occur on poorly drained sites throughout the Town. The most abundant wetland type in Wendell is forested deciduous swamp. Most of these swamps fall into the category of seasonally saturated, which means they have standing water at or above the soil surface during late winter, spring, and early summer of almost every year and they have saturated soils throughout the year during most years.

Important forested swamps in Wendell include Plain Road Swamp, Catamount Swamp, and a large swamp bordering Farley Road east of Perry Farm Road. Smaller swamps are common along streams and in low-lying areas that form the headwaters for many of the small streams that begin in Wendell. Some of these swamps are seasonally flooded but do not have saturated soils throughout the entire year. Important smaller swamps in Wendell include Sibley Swamp,

unnamed swamps near Wickett Pond and Ruggles Pond in the Wendell State Forest, swamps along the West Branch of the Swift River east of Cooleyville Road, and swamps bordering Whetstone Brook from its headwaters between New Salem Road and Morse Village Road north for a distance of approximately one mile. Small swamps along streams are often formed by the activity of beavers. Many of Wendell's wetlands, often overlooked, are remnants of decadent or former beaver swamps. Such beaver ponds occur along Osgood Brook in Plain Road Swamp, along the West Branch of the Swift River, in Sibley Swamp, along Damon Road near Ruggles Pond, along Whetstone Brook, and in numerous other locations throughout Wendell. These include both shrub deciduous swamps, and bogs. Bogs, which occur primarily near Ruggles Pond in the Wendell State Forest, are cited by the DFW as good examples of kettle hole level bogs, which are a variant of level bogs occurring in kettle depressions in sandy glacial outwash.

C.4 Aquifer Recharge Areas

The Town of Wendell has no existing municipal water supply and therefore relies solely upon private wells for its drinking water supply. (See also Section 3, Subsection D.2.2, Water Supply.) Given the continued growth of the Town, Wendell residents recognized the need for the location of aquifers. In 1994, Timothy Limbers, a graduate student at the University of Massachusetts, conducted a hydro-geological investigation for Wendell to determine potential aquifer locations as well as to recommend methods of protecting these aquifers.

In his study, Limbers found Osgood Brook Wetland, a kame-aquifer system, to be the most promising municipal groundwater supply for the Town. This aquifer is located in the headwaters of Osgood Brook, approximately one mile northeast of Wendell Center. It was found that the upper limit of developable groundwater from the Osgood Brook Wetland aquifer was 450,000 gallons per day. Another method of calculating developable groundwater determined the amount to be 170,000 gallons per day, which is considered to be extremely conservative, as it does not account for underflow and storage within the wetland. It was felt that some chemical treatment of water from this aquifer might be required to reduce concentrations of iron and manganese to acceptable levels. Two other major sites are Wendell's two largest groundwater basins, Mormon Hollow Brook and Whetstone Brook basins. The upper limits of these stratified drift aquifers were found to be over one million gallons per day for each (1.12 and 1.29 mgd, respectively). It is felt that these three sites potentially provide sufficient water supplies to meet Wendell's long-term needs. In addition to these aquifers, Limbers found five other areas with groundwater development potential. Other sites include: an area located in the headwaters of Mormon Hollow Brook west of Wendell Center that is underlain by water-bearing kame deposits and bedrock; an area along Whetstone Brook near the eastern border to Wendell containing kame, kame-delta, and kame terrace deposits; an area of kame deposits along Plympton Brook or Fiske Brook near Wendell's southern border; and two areas along the northern border of Wendell underlain by river-terrace deposits that may be capable of yielding large quantities of water.

C.5 Flood Hazard Areas

According to the Federal Emergency Management Agency (FEMA) Flood Hazard Boundary Maps for the Town of Wendell dated January 17, 1975, Special Flood Hazard Areas are located along the Millers River that forms the northern border of Town and along Whetstone Brook north of the Wendell State Forest.

C.6 Surface Water Reservoirs

Ten potential reservoir sites were identified by the U.S. Department of Agriculture (1974) in a survey of the Millers River Watershed. These sites were identified from topographic maps and the areas of potential open water impoundments were calculated. No information is available on water yields from these potential reservoirs. Four of these locations are along Whetstone Brook, three along Osgood Brook (including Bowens Pond), two along Lyons Brook (including Ruggles Pond), and one along Mormon Hollow Brook. In the Sawmill River sub-watershed, six potential and existing reservoirs were identified in the southwesterly corner of Wendell by the U.S. Dept. of Agriculture (1975) in a survey of the Connecticut River Watershed. These include upgrading existing sites on Fiske Pond and Tyler Pond and four new sites, three on Plympton Brook and its tributaries and one on Red Brook about 2,000 feet north of the Leverett town line. In the Swift River Watershed in the southeasterly corner of Wendell three potential reservoir sites were identified by the U.S. Dept. of Agriculture (1973) in a survey of the Chicopee River Watershed. Two of these are on the west branch of the Swift River and one is at the outlet of Sibley Swamp. No detailed plans were presented for these since they were on MDC land and presumably would reduce the amount of water reaching Quabbin.

The development of surface reservoirs for the purpose of increasing drinking water supplies would have at least two negative impacts on open space. First, by damming existing streams, many ecosystems and their inhabitants would be destroyed. The streams and their riparian areas would disappear, and the flow of water would be unnaturally removed from the sub-basin, which would affect groundwater recharge of local wetlands and associated plant and wildlife populations. The provision of ample drinking water supplies would also result in encouraging a level of population in-migration reflected in the build-out analysis. Both of these impacts are unacceptable to Wendell residents.

C.7 Public Water Supplies

The Town of Wendell has seven public water systems, according to DEP and MassGIS.³ There are four groundwater wells (Wells #1, 2, 3, and 4) and three transient non-community systems⁴

³ A Public Water System, as defined by the Massachusetts Department of Environmental Protection, is a system providing piped water to the public for consumption. A public water system has at least fifteen (15) service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days of the year.

⁴ A Transient Non-Community Water System is a public water system which serves twenty-five (25) different persons per day at least sixty (60) days of the year. Some examples of this type of system are restaurants, motels, campgrounds, golf courses and community centers.

located at the DCR Wendell State Forest, the Wendell Country Store and the Wendell Town Buildings. These are shown on the Water Resources Map at the end of this section.

C.8 Potential Sources of Water Supply Contamination

C.8.1 Sewage Disposal

All sewage disposal in Wendell is by private septic systems, aside from a common system serving public buildings in the center of Town. The effectiveness of these systems, particularly older ones, is variable and depends on topography, water table, and soils. This situation is not expected to change in the near future. The Wendell Board of Health is separate from the Selectboard and now employs a health officer to witness percolation tests. Installation of septic systems is overseen by board members. Seasonal limitations have been established for site evaluation activities. Approximately two to three failures are reported each year, caused primarily by age and improper design and installation. No direct discharges to water bodies are known. Dependence on private sewage disposal requires that housing be restricted to soils and slopes that can reasonably be expected to handle on-site sewage systems. Soil types are critical for determining this capacity, as many soils are shallow to bedrock, or have high probability of containing hardpans that would prevent adequate percolation and result in greater likelihood of system failure.

No accurate records are kept of the volume of septage generated. Wendell licenses septage haulers, but it is suspected that not all pumped septage is properly disposed of. The Publicly-Owned Treatment Works (POTW) #1 in Ervingside accepts septage from Wendell residents.

In 2002 Wendell received funds from the Department of Conservation and Recreation to study the septic systems in the area of the Town Commons. Systems in both private homes and municipal buildings were pumped and Title V assessments conducted. A number of these systems were found to be failing or inadequate. This study led the Town to hire the engineering firm of Dufresne-Henry to conduct an in-depth feasibility study of the alternatives available for sewage disposal with the final report completed in June 2005. Although the primary objective was to provide a sewage disposal plan for town-owned buildings, several alternatives were investigated, including a community system incorporating both private homes in need of septic repair near the center of Town and the former Lake Grove School. They also considered the possibility of constructing a sewer line to the Erving Center Sewerage Treatment Plant, although this proved too costly. Ultimately, the decision was reached to build a large conventional system on the site of the Town Office Building located on Morse Village Road. Only municipal buildings were initially connected. But the possibility of adding private residences was left open for future consideration. The design of this system, which is more than adequate for the current needs of town-owned buildings and which lends itself to future expansion, will serve the community for many years to come.

C.8.2 Acidification

Historically, streams and ponds in Wendell suffered damage as a result of acid rain. Because of the acidic nature of the granite and gneiss bedrock in Wendell, soils have a tendency to be very acidic and contain little capacity to buffer the effects of acid rain and snow. Data on pH⁵ were collected on nineteen streams and ponds in Wendell between March 1983 and January 1987 as part of the Massachusetts Acid Rain Project. The results were disturbing. Wendell is one of the worst hit areas in Massachusetts.

As a result, the Commonwealth has tried to help Wendell with its acidification problem. The Massachusetts Division of Fisheries and Wildlife (DFW) has proposed that Whetstone Brook be reclassified in the Surface Water Quality Standards (SWQA) as a cold water fishery (MassWildlife 2001). The DFW, as part of the National Acid Precipitation Assessment Program, in cooperation with the U.S. Fish and Wildlife Service Energy and Land Use Team, embarked on a five-year research project in the late 1980s and early 1990s to investigate counteracting the effects of acidity. Monitoring was conducted four years prior to and three years following treatment of the brook with limestone. The density of brook trout was found to increase significantly during the limestone treatment (Simmons et al. 1996).⁶

Table 4-2: Acidification Status of Wendell’s Streams and Ponds in 1987

Type of Surface Water	Acidified	Critical	Sensitive
<i>Streams</i>	Skerry Brook	Red Brook	Millers River
	Fiske Brook	Lyons Brook	
	Tyler Brook	Mormon Hollow Brook	
	Plympton Brook	Osgood Brook	
	Wickett Brook	Whetstone Brook	
		W. Branch Swift River	
<i>Ponds</i>	Bowens Pond	Fiske Pond	
	Ruggles Pond	McAvoy’s Pond	
		Tyler Pond	
		Sibley Swamp Pond	

Source: Town of Wendell Open Space and Recreation Plan; 1987, 2002.

C.8.3 Other Sources of Potential Water Supply Contamination

There is one poultry farm and no dairy herds in Wendell. Disposal of agricultural waste is not a significant problem. There have not been major problems of erosion associated with forestry activities, though there may be temporary erosion and stream siltation problems at logging sites. Stormwater runoff from paved areas currently is minimal since Wendell is not highly urbanized. It is suspected that the volume of stormwater runoff will not be a problem in the near future with the exception of very local damage to unpaved roads. Contamination of surface or groundwater by runoff containing a high concentration of road salt may be a problem in some locations. There is, at present, no information on the nature of any salt contamination problem. Automobile salvage yards, service garages, and auto body shops can pose a threat to water quality, unless precautions are taken to avoid this. In the absence of zoning-defined commercial

⁵ A pH is a measure of the concentration of hydrogen ions. A pH of 7 is neutral, a pH below 7 is acidic and a pH above 7 is alkaline.

⁶ Millers River Watershed 2000 Water Quality Assessment Report.

and industrial land use zones and a Special Permit Process, the Select Board can only address water quality problems posed by these operations in a back-door fashion. The threat to groundwater quality is immediate, and Wendell should not rely on the indirect measures so far available for its protection. The Town's automobile salvage industry presents large challenges, both aesthetically and environmentally. Herbicide spraying along railroad and utility rights-of-way must be monitored to assure the safety of nearby private and public water supplies. Wendell no longer has a municipal landfill. In its place on the same site on New Salem Road, is a recycling and transfer station where all Wendell's waste is collected and sent out to either be recycled or deposited in a landfill. This should cause no local problems with hazardous leachate. However, the previous landfill has never been capped and the possibility of leachate from the old use cannot be ignored. To detect this, should it occur, inspection wells have been installed around the periphery of the old landfill. The Hazardous Waste Coordinator is currently involved in locating and identifying other sources of potential pollution.

C.9 Analysis

Water resources in Wendell are ample. This is an enviable condition in most respects, which Wendell residents can feel some pride in because they have not grown so fast as to remove more water from their aquifers than is currently being recharged. Wendell would appear to have a positive water supply. Unfortunately, acid rain compounds the natural non-buffering characteristics of the bedrock so that many of the Town's fishing places are too acidic for trout. And, unfortunately, the shallow wells are vulnerable to septic failures. This is one reason the Town has a three-acre minimum lot size in their zoning, so that a septic field can safely be separated from a private well. Perhaps in the future, Wendell residents may plan on establishing a public wastewater treatment facility and a public drinking water supply. For now, it may be important for Wendell residents to habitually test their water and check their septic systems.

There are a variety of opportunities for Wendell Residents and town departments to get involved the stewardship the Millers River and other local water bodies. The Millers River Watershed Council, Massachusetts Riverways, and the Massachusetts Water Watch Partnership offer ongoing programs as well as training and support for those interested in volunteering to support local water resources. There are also local stretches of stream and riverbanks that would benefit from inclusion in any local clean-up days.

D. VEGETATION

D.1 General Inventories

There are two fold-out tables in Appendix E which identify and categorize plant species by plant community and habitat type: dry and wet. Within the dry habitat type are found forest and field categories that are broken further into softwood, mixed softwood/hardwood, hardwood, old field and grazed field. The forest types are further defined as white and red pine, pitch pine, hemlock-

northern hardwoods, and oak-hickory. The tables also differentiate between vegetation layers: dominant over-story trees and associated and under-story trees, shrubs and herbs. In addition, a description of the habitat is included. The absence of documented rare and endangered species in dry habitats is curious but not uncommon. Most of the rare or endangered plant species in Massachusetts are associated with wetland habitats.

Within the wet habitat table, plants are separated into forestland and grassland that are broken further into types: bog, swamp and floodplain, marsh, and wet meadow. Again like the dry habitat table, these plant species are also categorized by layer: dominant over-story trees, and associated and under-story trees, and shrubs and herbs. In addition to habitat information, the table differentiates between rare or endangered species that are documented and those that are "associated" in Wendell, i.e., those for which suitable habitat exists.

The Environmental Habitat Map at the end of this section shows Priority Habitat of Rare Species, Biomap2 Core Habitats, and BioMap2 Critical Natural Landscapes identified by the Natural Heritage and Endangered Species Program (NHESP). The Biomap2 data was released in November 2010. In addition, the Environmental Habitat Map shows 1830's woodlands identified by the Harvard Forest in an effort to locate possible Primary Forest Areas.

D.2 Forests

Forest areas are considered the Town of Wendell's most important natural resource. As of 2005, forests comprised 90% of the Town's total land area. Between the years 1999 and 2005, the Town of Wendell experienced a net loss 207 acres of forest land (MassGIS).

Forests provide for many of Wendell's available recreational opportunities including walking, hiking, fishing, skiing, snowshoeing, horseback riding, hunting, snowmobiling, picnicking, and nature study. Access to the forests is primarily from numerous woodland roads throughout the Town, Wendell State Forest, and Whetstone Wood Wildlife Sanctuary.

Forests in Wendell are classified as transition hardwoods-white pine forest (USDA; 1992). Within this forest type, northern hardwoods such as yellow and paper birch (*Betula alleghaniensis* and *Betula papyrifera*), beech (*Fagus grandifolia*), and sugar and red maple (*Acer saccharum* and *Acer rubrum*) are the major species. On the dryer sites, oaks and hickories can be found with red oak (*Quercus rubra*) being the most abundant deciduous species. Hemlock (*Tsuga canadensis*) occurs in the moist cool valleys, north and east slopes, and sides of ravines of Wendell. White pine (*Pinus strobus*) is characteristic of the well-drained sandy sites. The transition hardwood-white pine forest type commonly occurs up to an elevation of 1,500 feet above sea level in upland central Massachusetts and southern New Hampshire, northward through the Connecticut Valley. An interesting minor shrub or small tree on uplands is *Eleagnus commutata*, the Silverberry. The Wendell population likely represents outlying southerly 'vagrants' from the species' main Canadian (Quebec, Ontario) range. Noteworthy is that the plant is one of the few non-legumes able to fix nitrogen in the soil.

The shallow, acidic soil of Wendell supports a fragile system of plants and animals easily degraded by human activity. Tree growth is slow where trees rarely reach a height over 75 feet. Slopes laid bare by the bulldozer stay clear for years with even the toughest annuals and grasses creeping in slowly. Logging and re-logging, with reproduction left to chance and stump sprouts, have left many areas with poor quality forest of low height and less species diversity than in earlier times. Environmental stressors such as air pollution have taken a toll on the forests of Wendell, particularly in the western and southern portion. It remains to be seen whether specimens (not to say populations) of all original indigenous plants still remain in Wendell, with one notable exception, the American chestnut that is only present in Wendell as stump sprouts.

Along the Millers River, in the Town of Wendell, there is an unusual example of floodplain forests (letter from DFW; 2000). Such floodplain forests are known to occur along main stem sections of large rivers and have silver maple (*Acer saccharinum*) strongly dominant in the overstory, with over 60 percent cover, mixed with lesser amounts of cottonwood (*Populus deltoides*). American elm (*Ulmus americana*) and/or slippery elm (*Ulmus rubra*) occur in the sub-canopy. Shrubs are generally lacking in the floodplain forest. The herbaceous layer is usually dominated by a three- to six-foot tall, dense cover of wood-nettles (*Laportea canadensis*), and ostrich fern (*Matteuccia struthiopteris*) is sometimes abundant. Whitegrass (*Leersia virginica*) is consistently represented but in low amounts. Other common associates are wood reed (*Cinna arundinacea*) and jack-in-the-pulpit (*Arisaema triphyllum*). Floodplain forests are insect-rich habitats that attract warblers, thrushes, and other songbirds. Raptors such as bald eagles and red-shouldered hawks also use riverbank trees as perch sites. Wood ducks and hooded mergansers are found along the shady edges of the riverbanks, as are Eastern comma butterflies and several species of dragonflies. Floodplain forests also provide sheltered riverside corridors for deer and migratory songbirds.

Several smaller areas of Wendell's many forests are among those throughout the state identified as possible Primary Forests. Primary forests are not Old Growth, they have been harvested and pastured, but the ground may not have been tilled. Such lands have greater biodiversity than those lands that have been tilled, according to Natural Heritage & Endangered Species Program Ecologist Patricia Swain (NHESP). A statewide map of possible Primary Forests was created after Harvard Forest digitalized maps from the 1830's. NHESP GIS staff took those data and combined them with information from MassGIS' landcover datalayer from 1999 aerial photos. Some of the areas that were forested in both the 1830's and 1999 will never have been tilled. Surveys of soil structures in the individual sites are necessary to determine whether those sites are primary forests. Such untilled areas retain more native biodiversity including soil fauna and flora, microorganism, plants that reproduce primarily vegetatively, and wildflowers. Swain suggests targeting such areas for areas of 1830's on private lands for conservation acquisition to maintain the biodiversity of the town and region.

With assistance from NHESP, the North Quabbin Regional Landscape Partnership produced a map in 2008 showing interior forest blocks in Wendell that are among either the largest 1% or 10% of interior forest blocks statewide. While these forest blocks cover a much larger area than the potential Primary Forests, together they comprise less than a quarter of the Town's forestlands. Large unfragmented forest blocks provide the best opportunities to maintain species and limit species loss from Town, according to Swain. There are four forest blocks in Town that

that are part of the largest 1% of the interior forest blocks statewide. Much of this land is permanently protected, but unprotected parcels scattered each of these areas. These areas are located in the far southwestern and southeastern corners of Town straddling Leverett and Shutesbury, in the northern central area of town south of Farley, and Erving, and along the boundary between Wendell and Orange. The bulk of the approximately 250 acres of Town Forest in the southwestern corner of Town are in that block of forest. Most of the rest of that forest block is managed by the DCR. Much, but not all, of the forest block to the south of Erving and the Millers River is permanently protected by the state. The largest area that is a part of the largest 1% of interior forest blocks that is not permanently protected is along the southern edge of the Town's eastern border. The majority of the lands within the largest 10% of interior forest blocks are permanently protected, but there are patches of unprotected parcels scattered throughout these forest blocks.

EOEEA has held seven "Forest Forums" with 35 leaders of the industry, professional foresters, landowners, and conservation organizations. This group endorsed and is working to achieve five goals for the forests of Massachusetts, according to the *Open Space Planner's Workbook*. These include protecting a base of forests, sustaining the economic viability of our forests, striking a balance between working forests and forest reserves, protecting the health of our forests, and educating key groups about the value of our forests. A variety of resources exist regionally and statewide to assist the Town and local forest landowners in furthering these goals.

NQRLP sponsored a series of Woods Forums in Eastern Franklin County in 2008 designed to help connect woods landowners with each other and foresters to discuss and share information about woodland ownership. Each forum included several neighboring towns and included information on issues such as timber harvesting, natural resource conservation, development of forestland, and the local forest economy. Also in 2008 the NQRLP sponsored a series of Conservation Forums focusing on important unprotected areas including forestland.

Western Massachusetts forest landowners have created the Massachusetts Woodlands Cooperative to foster sustainable forestry via Forest Steward Council "Green Certification" and cooperation on processing and marketing of local products. (www.masswoodlands.com) The state offers several programs related to forest stewardship. A website created by UMass Extension Service for forest landowners that is a clearinghouse of information on Massachusetts forests (www.masswoods.net). The Forest Legacy Program, a USDA Forest Service program offers grants for the acquisition of threatened forest tracts of statewide significance (www.mass.gov/dcr/stewardship/forestry/other). The Forest Stewardship Program, a USDA Forest Service and EOEEA program, offers cost-sharing for the cost of forest management plans and implementing sustainable forestry practices to landowners and municipalities (www.mass.gov/dcr/stewardship/service).

The *Open Space Planner's Workbook* created by EOEEA also recommends that towns reference the *Guide to Chapter 61 for Municipalities* created by the Mount Grace Land Conservation Trust. This document contains a sample town policy for responding to situations in which the Town has an opportunity to exercise the right of first refusal. This sample was used by the Wendell Open Space Committee in finalizing a policy for use by the Town.

Outside of state forests and the more prominent privately protected lands, the remaining forest lands in Wendell fit into a category called non-industrial private forest lands, or NIPF's. A 1998 article in the *Journal of Forestry*, "Ecosystem Management: Capturing the Concept for Woodland Owners" described the results of a survey of Franklin County NIPF owners. The results of the survey included the top five reasons for forest land ownership: privacy, personal use of wood products, aesthetics and beauty, part of residence, and recreation. The survey also provides selective information on a sample of woodland owners: most live less than a mile from the land; 60 percent have owned the land for at least 15 years; 60 percent own less than 50 acres; 62 percent have annual household incomes of less than \$55,000; and 48 percent are over 55 years of age. The main results of the study show that Franklin County NIPF owners may hold attitudes that are favorable towards three concepts of ecosystem management: one's land fits into a larger ecosystem; one's land has smaller parts important to their own property and the larger landscape; and, one's land should be managed for today's uses and for future generations. The results of this study also suggests that Wendell NIPF owners may be open to participating in cooperative conservation measures that would seek to protect natural resources that cross property lines, including drinking water supplies and wildlife.

D.3 Agricultural Land

Agricultural land in Wendell, which includes pasture and croplands, comprises less than two percent (1.25%) of the Town's total land area, and is a rare and valued aspect of the landscape resources in Town. Agricultural land can be found around the Town Center along Wendell Depot Road and Lockes Village Road; in the southern section of Town along Jennison Road, West Street and Locke Hill Road; in the northwestern section along Farley, Davis, and Mormon Hollow Roads; and in the eastern section along New Salem and Jennison Roads. (See the Prime Farmland and Development Restraints Map at the end of this section.) Valued not only for its contribution to the local economy, agricultural land is important in Wendell for its contrast to the predominance of forest land, providing scenic landscapes and open vistas. The Town's open fields also provide sustenance for many species of wildlife including migrating birds. Opportunities for recreational activities on these lands include sledding, snowshoeing, snowmobiling, and cross-country skiing.

Although Wendell's farmlands are not ideal for crop vegetables or turf as are fields in the Connecticut River floodplain, they still provide employment opportunities and incomes for residents and thus should be valued now and for the future. The 1999-2000 Winter issue of *Massachusetts Benchmarks* included an article by Holm, Lass, and Rogers, "The Changing Landscape of Massachusetts Agriculture." According to the study, which relies on Census of Agriculture information, trends in agriculture across the state over the past twenty-five years include decreasing agricultural acreage, decreasing farm size, increasing numbers of farms and increasing profitability. Franklin County, like many counties in the state, lost many of its dairy farms. However, roadside stands, pick-your-own crops, and subscription farms played a major role in increasing profitability of the remaining farms. In sum, farmland in Wendell, comprised mainly of small parcels, is a resource that residents should not allow to disappear.

D.4 Wetland Vegetation

The forested deciduous swamp is the predominant wetland type in the Town of Wendell. These areas are essentially red maple swamps, although in New England, the usual swamp hardwood type is referred to as elm-ash-red maple (*Ulmus americana- Fraxis* spp. -*Acer rubrum*). Black spruce (*Picea mariana*) can also be found. Also common in Wendell are mixed deciduous swamps that include eastern hemlock (*Tsuga canadensis*). Wetland understory shrubs are common in these swamps and can include mountain holly (*Nemopanthus mucronata*), high-bush blueberry (*Vaccinium* sp.), and winterberry (*Ilex verticillata*). Herbaceous vegetation such as sedges (*Carex* spp.), ferns, false hellebore (*Veratrum viride*) and skunk cabbage (*Symphlocarpus*) are also found. (USDA; 1992)

There are a number of shrub-scrub wetlands in Wendell. These include both shrub deciduous swamps and bogs. According to a letter from Massachusetts DFW (2000), Wendell has a good example of a kettle hole level bog in Wendell State Forest. Kettle hole level bogs have vegetation in a ringed zonation pattern. Often, the outer wet moat is dominated by a mixture of high-bush blueberry (*Vaccinium corymbosum*) and swamp azalea (*Rhododendron viscosum*) bordered to the interior by a ring of rhodora (*Rhododendron canadense*). The peat mat has a mixture of tall and short shrubs that are predominantly ericaceous (members of the Heath family). Leatherleaf (*Chamaedaphne calyculata*) is dominant. Other typical ericaceous shrubs include rhodora, sheep laurel (*Kalmia angustifolia*), bog laurel (*Kalmia polifolia*) bog rosemary (*Andromeda polifolia* var. *glaucophylla*), Labrador tea (*Ledum groenlandicum*), and low-growing large and small cranberry (*Vaccinium macrocarpon* and *V.oxycoccus*) occur throughout. Scattered, stunted coniferous trees, primarily tamarack (*Larix laricina*) and black spruce (*Picea mariana*), also occur throughout. A mixture of specialized bog plants grow on the hummocky sphagnum surface, including carnivorous pitcher plants (*Sarracenia purpurea*) and sundews (*Drosera rotundifolia* and *D. intermedia*) (Classification of Mass. Palustrine Natural Communities; 2000).

Emergent marsh wetlands in Wendell occur only in small isolated locations or intermixed with trees in the deeper more permanently flooded portions of swamps. Typical emergent marsh vegetation consists of cattail (*Typha* spp.), burreeds (*Sparganium eurycarpum*), and sedges (*Carex* spp.). Wetland areas in Wendell are popular sites for bird watching and habitat exploration.

D.5 Public Shade Trees

Wendell has a history of protecting public trees. In the 1970s, the Annual Town Meeting passed a bylaw that classified all town roads as scenic. The bylaw requires a hearing with the Tree Warden and Planning Board before cutting or removing any trees for road reconstruction, paving or maintenance. The number of residents who have attended hearings when significant roadside cuts have been proposed shows the town's continuing interest in roadside shade trees. Also in the 1970s, the Annual Town Meeting voted to use a low percentage of road salt for winter sanding of roads, minimizing salt damage to roadside trees.

Shade trees are important landscaping elements at the Town properties in the center of Wendell; the Town Offices property on Morse Village Road; the Common which is surrounded by Morse Village Road, Center Street, Wendell Depot Road, and Lockes Village Road; the Senior Center on Lockes Village Road; the Wendell Free Library on Wendell Depot Road; and the Center Cemetery on Center Street.

At the Town Offices property, the Landscaping Committee appointed by the Selectboard planted and maintains a crabapple tree on the north side of the building. A mature maple tree is located on the south side of the building and a locust was planted to shade the entryway to the building. A row of cedars west of the building was planted as a screen between the Town Office building and the abutting property. Also at the Town Office property, at the Community Garden, one cherry and two pear trees are part of the initial plantings in a half-acre permaculture garden. Additional plantings of fruit trees and nut trees is planned for this permaculture garden. The community garden committee appointed by the selectboard maintains the permaculture garden trees.

The Town Common is divided by Morse Village Road into a north section and a south section. In the north section, a row of crabapples is present along Wendell Depot Road. Mature maples line the perimeter along Center Street. The south section of the common has several oak trees, and maples of various ages. Some of the trees on the north section of the Common appear to need maintenance; there are dead limbs and insect damage. At the Senior Center property, across Lockes Village Road from the Common, there are maples north and east of the building.

At the Wendell Free Library, a tree is located east of the building, and a locust provides on the south side of the building provides shade for the building. At the playground area of the library property, two mature maples and a butternut provide shade. A young tree is located near the ball court.

Wendell has three large wooded town conservation areas where important public trees are located. These are: 1) the Fiske Pond Conservation Area; 2) the Montague Road Town Forest/Conservation Area; and 3) the Phelps Forest Conservation Area. There are also two smaller conservation areas to the north and south of Farley Road. The Fiske Pond Conservation Area and its vegetation are discussed below in Section F.1.2, Special Ponds.

The Montague Road Town Forest/Conservation Area consists of 144 wooded acres, predominantly oak and mountain laurel. A portion of this conservation area was deeded to the town by J.W.H. Phelps in 1888 for the purpose of supporting Wendell schools through wood and timber harvesting. This property is maintained by the Conservation Commission under a stewardship plan to protect wildlife habitat and improve timber growth for future generations. According to the 2006 forester's report, the trees on this property will take 35 to 65 years to reach harvesting maturity. Actions recommended in the plan include clarification of ownership and boundaries, developing habitat protection guidelines, conducting an initial demonstration thinning, and documenting vernal pool usage. The Wendell Open Space Committee has begun to implement the recommendations in this report. The largest vernal pool on the property was certified in 2008 and the initial demonstration thinning was completed in early 2009.

The three other lots that were also part of the 1888 Phelps deed to the town have also been designated as conservation land with the directive that proceeds from the wood and timber be used to support local schools. There is a landlocked 17.5-acre parcel north of Farley Road (tax Map 407, Lot 48), a parcel of approximately 39 acres south of Farley Road (tax Map 407, Lot 38.10), and a landlocked parcel of approximately 37 acres near Old Egypt Road (tax Map 401, Lot 17.2). The types of trees found at each lot are described in the forester's report prepared by Michael Mauri in 2008 for the Wendell Open Space Committee. These descriptions are summarized below.

- The 17.5-acre parcel north of Farley Road consists of maturing upland oak (red oak) with abundant beech and red maple and less black cherry and paper birch, with a hemlock and hardwood swamp mix with limited black gum.
- The 39-acre parcel south of Farley Road is a tall dense closed canopy forest with the exception of a small area of shrub swamp (blueberry swamp) and one interior shrub swamp/probable vernal pool. Forest types are either nearly pure mixed hardwoods or hemlock and hemlock-hardwood mixes. The hardwood portions include are area of sugar maple and ash, one area of oak, beech and red maple, and areas of red maple beech and birches.
- The 37-acre parcel off Old Egypt Road is predominantly a maturing red oak forest, probably dating to approximately 1900-1920. Other hardwoods mixed in the overstory are white oak, black oak, beech, red maple, paper birch, black birch and beech. Pine is not common at all.

The management recommendation presented in the 2008 forester's report for the 17.5-acre parcel north of Farley Road includes a focus on protecting an oak and beech knoll and the hemlock hardwood swamp and non-harvest cutting in the hemlock hardwood swamp to create small openings to regenerate hardwoods. The management recommendation presented for the 39-acre parcel south of Farley Road is a "selection system" in which no-cut areas and species that should not be reduced in abundance are identified. Trees would be selected for harvest either singly or in groups, thinning around the crowns of desirable trees. The selection system would remove firewood and limited hemlock.

The management recommendation presented in the forester's report for the 37-acre parcel off Old Egypt Road is to consider this parcel as a unit with other contiguous Town-owned land and develop a management plan for the entire area. Firewood thinning is recommended to create more space around the crowns of established oaks. Based on these recommendations the two lots adjoining the 37-acre lot were also designated as conservation land in 2008 to create the 126 acre Phelps Conservation Area.

D.6 Rare, Threatened and Endangered Plant Species

The Natural Heritage and Endangered Species Program, a program of the Massachusetts Department of Fisheries, Wildlife and Environmental Law Enforcement, identified 259 native

plant species as rare in the Commonwealth. The Massachusetts Natural Heritage and Endangered Species Program has documented two vascular plants in the Town of Wendell as threatened

The Adders's-tongue Fern (*Ophioglossum vulgatum* L.) is a small terrestrial fern up to twelve (12) inches high, consisting of a single fleshy green stalk (stipe) bearing a simple leaf and fertile spike. No other fern looks like the Adder's-tongue. The plant appears anytime after early June. The Adder's-tongue is found in boggy meadows, acidic fens, borders of marshes, wet fields, and moist woodland clearings providing suitable open and sunny habitat. It was once a widespread species in Massachusetts during the century of extensive agricultural clearing. There are only eight known occurrences in the state; however, it is possible that undiscovered populations exist in Massachusetts, but the increasing rarity of appropriate open habitat appears to be a major factor in its decline.

The Pale Green Orchid (*Platanthera flava* var. *herbiola*) is a leafy, single-stemmed terrestrial orchid, six to twenty-four inches tall, growing from fleshy, tuber-like roots that spread slowly into small clumps or colonies. Flowering normally occurs from mid-June through mid-July. This orchid grows in swamps, floodplain forests, and more open habitats and requires full or partial sun. Forest succession of its open habitats and continued urbanization are thought to be a major cause for its decline.

Both Adder's-tongue Fern and Pale Green Orchid were more common when pastures and open fields were more abundant, and now tend to be found in places where there are periodic disturbances that keep the land open. Neither of these species has been reported in Wendell since the 1930's. The Mountain Wood-fern, on the NHESP Watch List, is a species of cool moist woods, usually with acidic soils—not an unusual habitat in Wendell.

D.7 Invasive Species & Introduced Pests

The Massachusetts Invasive Plant Advisory Group, (MIPAG) a collaborative effort of state and federal government agencies and private organizations that serves the Commonwealth in an advisory capacity, defines invasive plants as “*non-native species that have spread into native or minimally managed plant systems in Massachusetts. These plants cause economic and environmental harm by developing self sustaining populations and becoming dominant and or disruptive to those systems.*” Invasive plants can impact the Massachusetts environment by competing with native plants for natural resources, dominating habitats and reducing food and shelter for native wildlife, according to *A Guide for Invasive Plants in Massachusetts*, a 2006 guide by members of MIPAG. Invasive plants can also eliminate the host plants of beneficial resident native insects and compete with native plants for pollinators. At times this can cause biologically diverse forests, wetlands and meadows to be dominated by one of several non-native invaders.

Many invasive plants that can be found in neighboring towns and in the valley have not made their way up to Wendell, according to Paul Godfrey, retired professor of Botany at UMass. This is especially true of aquatic plants. This has occurred because invasive aquatic plants in the

lakes and pond in nearby towns including Lake Wyola and Leverett Pond towns spread primarily by the trailers that are used for motor boats which are commonly used in nearby towns, but not in local ponds. While Wendell has fewer problem species than many neighboring towns, several invasive plants have become problematic locally over the last decade. Several of these plants including the shrub Glossy Buckthorn (*Frangula alnus*) tend to move into newly cleared areas, such as the area of town North of Montague Road that were disrupted by the tornado in 2007. Godfrey said that glossy buckthorn, which has been moving into both the forests that were cleared by the tornado and heavily logged sections of state lands, grows in dense stands that block the light for hardwood seedlings as well as other forest plants. These newly open areas can serve as pathways for the plant, which must be manually removed, to spread through town. Some other invasive plants that Godfrey and his wife Melinda have noticed settling into locations in Wendell include: Japanese Barberry (*Berberis thunbergii*), Oriental Bittersweet (*Celastrus orbiculatus*), and Multiflora Rose (*Rosa multiflora*). The Conservation Commission is also concerned about the spread in local wetlands of the Common Reed (*Phragmites australis*), a clonal grass species which can grow up to six meters in height in dense stands, and the Mile-a-Minute Vine (*Persicaria perfoliata*), an herbaceous annual trailing vine.

Japanese Knotweed (*Polygonum cuspidatum*), an upright perennial herb, has also become a problem in Wendell over the last decade. This plant, grows to ten feet tall with bamboo-like stems, large heart shaped green leaves, and white flowers. It is often found near water sources, along streams and roadsides and once established it is very difficult to eradicate and can regenerate from a small piece of root. It suppressed the growth of native plants and in the process and degrades wildlife habitat. The Deerfield River Watershed Council has been working to eradicate this plant in their watershed and produced a fact sheet on Knotweed including methods for controlling it without the use of herbicides (www.deerfieldriver.org/invasives). Some strategies include pulling for small patches, repeated mowing, cover with black plastic for an entire growing season. Grazing livestock may help to control the plant from spreading, but will not eradicate it. Proper disposal of plants that have cut is critical to prevent further infestations. They must either be buried ten feet deep or dried out completely and composted or burned.

Information on managing other invasive species can be found online at www.invasivespecies.net. The website for the National Invasive Species Information Center at www.invasivespeciesinfo.gov/unitedstates/ma/shmtl is a clearinghouse for information on the general topic. The Massachusetts Introduced Pests Outreach Project is a collaboration between the Massachusetts Department of Agricultural Resources and UMass Extension Agriculture and Landscape Program aimed at increasing awareness about introduced pests among professionals in agriculture, horticulture, and government. Their website (www.massrcn.org/pests) has fact sheets on pests including, insects, weeds, diseases affecting vegetables, flowers, fruits, landscaping, forestry and natural areas and offers pest alerts.

A pest of special concern since 2008 is the Asian longhorned beetle, a destructive wood boring pest of Maple, Birch, Willow, Polar, and other hardwood trees. State officials have been on alert for this pest, especially since the first sighting of this beetle in Massachusetts in Worcester in August 2008. The larva of this shiny black beetle with white spots damage the tree by eating away at the outer sapwood creating hollowed out sections in the wood. The beetles drill ½ inch

round holes in trees and large amounts of coarse sawdust. Residents are encouraged to capture any beetles, freeze them to kill them, and contact state forest officials immediately. The Asian longhorned beetle was first discovered in the United States in 1996 in Brooklyn, New York in 1996 and has since been seen in several counties in New York and New Jersey, and even as far away as Chicago and Toronto. Some of these counties have since been declared free of this pest, according to a North American Plant Protection Organization's pest alert report (www.pestalert.org).

D.8 Analysis

Plants and animals are the visible 'citizens' of the ecosystems in Wendell. Plants convert solar energy into food. This food supports all animal life. Plants cycle energy through the ecosystem by decaying, by removing carbon, and by releasing oxygen. Plants help moderate temperatures. Plants act as shelter and as feeding surfaces for herbivores, omnivores, and carnivores.

It is easy to take plants for granted because they are the backdrop for our daily activities. Fields, a maintained stage of human-caused vegetation, are rare in Wendell and thus valued. Forests on the other hand are plentiful and may appear as common. However, everything that is discussed in this Open Space and Recreation Plan points to the importance of forests: they protect aquifers, first and second order streams, and edge and interior habitats; they clean the air and cleanse the water; and, they can provide us with materials, food, and medicines to support our human community. Forests of all types and habitats, densities, ages, and sizes are what would predominate in our absence.

Information contained in several MassGIS data layers produced in recent years can assist the Town and the Wendell Open Space Committee in further identifying areas of forest that warrant special consideration as high protection priorities (see the Environmental Habitat Map at the end of this section). These data layers include Possible Primary Forests, Interior Forest Blocks that are among the largest 1% and 10% forest blocks statewide. (These data layers are shown on the Protected Open Space Map at the end of Section 5.) Further study of soils in the 1830's forests would be helpful in positively identify possible Primary Forests. The Town can take steps to protect these special forests by determining which sections of these areas remain unprotected at a parcel level and noting which of these parcels are currently under Chapter 61, as well as participating in regional efforts to coordinate sustainable management of local forestlands. Further study on the ground will be needed in order to access which areas of Potential Primary Forests have actually not been tilled over the years. Indicators such as the presence of stone walls suggest that land has been tilled according to Wendell resident David Richard who is a Managing Forester for Bureau of Fire Control and Forestry of DCR. Finally soil samples can be collected from sites that appear to be primary forests and analyzed to determine if they are indeed from primary forests.

Agricultural land and especially land containing prime agricultural soils is very limited in Wendell at present and serves many vital roles including contributing to the local economy, providing scenic landscapes and opportunities for recreation, and providing sustenance to Wendell's human and non-human residents. Thus preserving our agriculture lands and open

fields is among the Town's most vital preservation priorities. As with forest lands the Town can make use of the GIS layers on the Maps included in this plan to identify unprotected parcels of agricultural land and those with temporary protection under Chapter 61 while developing a parcel level list of protection priorities. The amendments to the Town's Zoning Bylaws that are currently being crafted are designed assist in protecting both the Town's agricultural lands and its forests from intrusive developments. Town officials may wish to consider additional measures to protect our farmlands and prime agricultural soils.

Several invasive plant species have been occurring in increasing numbers in Town in recent years. Any attempts at effective containment of the spread of invasive species locally will depend on the ability of the WOSC and other local boards and committees to effectively educate local officials, highway department employees, and residents about these species and recommended management strategies. The same can be said regarding any introduced pests such as insects or diseases that may impact Wendell's forests and other local vegetation in coming years; effective public education will be essential to efforts to mitigate the impacts of such problems.

E. WILDLIFE

E.1 General Description and Inventory of Wildlife and Wildlife Habitats

A table entitled Wildlife Habitats: Representative Wildlife Species of Western Massachusetts is located in Appendix E and categorizes species by habitat type: woodland, open land, open water, and wetland. The table includes insects, fish, reptiles, amphibians, birds, and mammals. Rare and endangered species include both documented and associated species.

E.2 Vernal Pools

Vernal pools are small depressions that fill with water from snowmelt, spring rains, and high ground water in the spring. They are critical breeding areas supporting several species of wildlife totally dependent on the vernal pool habitat for their survival. These species include frogs, salamanders, and invertebrates. Vernal pools are also valuable for their role in water management as well as their habitat values. The Town of Wendell has seven certified vernal pools; many more await certification. Two certified vernal pools are located off Locke Hill Road northeast of South Cemetery and two are located off New Salem Road, one in the area near the power lines and one in the area of the intersection with Jennison Road. Two are located south of New Salem Road and east of Rush Place Road. The seventh is located in the Town Forest near Montague Road. (See the Water Resources Map at the end of this section.) The Wendell Wetlands Bylaws protect all vernal pools.

An additional twenty-six potential vernal pools have been identified from aerial photographs and are available as a GIS layer. These sites need verification on the ground. There are several clusters of potential vernal pools that provide extra habitat value for the species that use them as

each pool is somewhat different and provides alternate habitats in different years and seasons. It has been suggested that clusters of vernal pools that are located on “1830’s forests” are especially good areas for protection. (NHESP, letter)

E.3 Corridors for Wildlife Migration

Individuals of wildlife and fisheries populations move within a landscape. Why, when, and where wildlife and fish species move is not completely understood by wildlife biologists. What can be said with certainty is that given a mostly undeveloped landscape, animals do not pay attention to political boundaries. What can be also said with certainty is that in a developing landscape, wildlife seek natural cover for shelter and food, but willingly forage where human uses, such as horticultural and ornamental plantings, provide browse or food. As the land within the Town of Wendell continues to be developed, the remaining remote large blocks of forest land, and the parcels of land connecting them together, will become more important to area wildlife.

Wendell is located within several regional belts of protected open space that contribute to the value of the already protected land in Town. The Quabbin Reservoir Wilderness protected from development by the DCR, other state agencies and private land trusts, is a source of wildlife for surrounding communities. It is probable that wildlife moves from and into the Quabbin area by way of sparsely or undeveloped open space, crossing roads when necessary. Roads are a form of connection for humans but they are an impediment to wildlife movement. In addition, they also reduce the size of wildlife species populations through road kills. Roads are also barriers for such forest interior species as the Scarlet Tanager.

Connections between bodies of water and sub-watersheds are also important for wildlife and fisheries species. The more common animals that utilize the river and stream corridors are beaver, muskrat, raccoon, green heron, kingfisher, bittern, snapping turtle, and many species of duck, amphibians, and fish (Millers River Advisory Board; 1983). Since many species rely on a variety of habitats during different periods of their life cycle, species diversity is greatest in areas where several habitat types occur in close proximity to each other. With this in mind, the protection of all habitat types is vital for maintaining and enhancing biodiversity in Wendell.

How do we determine the quality of the wildlife habitat in Wendell and the most appropriate conservation strategies? There are three general paths to follow in conserving the health of wildlife populations. One way is to protect the habitat of specific species that are rare, threatened, or endangered. It is thought that while protecting their habitats other species will also benefit. A second path is to conserve certain landscape level resources like a large contiguous forest or riparian habitats along rivers. This helps to conserve the habitats of a large number of species but it might lose sight of some rare and endangered species. The third method is a combination of the two. Conserving the long-term biodiversity of the management area requires efforts to protect unique habitats, networks of habitats that assist population dynamics, and landscape level resources like large contiguous forest patches and riparian areas.

NHESP has produced a number of maps and GIS data layers to assist in the process of identifying each of these approaches to habitat conservation. In addition to maps identifying the largest tracts of forest lands, the BioMap2⁷ and Living Waters cores were produced by NHESP to identify the areas of most importance for biodiversity, based on known locations of rare species and uncommon natural communities, and incorporate the habitats needed for such species maintain their local populations. These maps were produced for conservation planning purposes, unlike Priority and Estimated Habitats that are regulatory maps used by the Conservation Commission. The BioMap2 focuses on upland and wetland species, and Living Waters focuses on aquatic species. There are several BioMap2 core habitats in Wendell. The large BioMap2 core around the Quabbin, which is a very important area for biodiversity protection, extends into parts of southeastern Wendell. Whetstone Brook and part of Mormon Hollow are core areas of importance to cold water fisheries. Other local core habitats include the Kettle Hole Level Bogs and Acidic Cliff Communities. (See the Environmental Habitat Map at the end of this section.)

Recognizing the general areas where wildlife mate, feed, and travel is often a first step in conserving the health of wildlife habitats. Large, round forest patches of more than 185 acres provide interior forest habitats for a variety of birds and mammals, as well as protection of first and second order stream tributaries (Formann; 1995). Networks or greenways of protected forestland or vegetated riparian corridors are resources that will help to sustain populations of animals that require diverse habitats over time and space. There is a great degree of forestland that is permanently protected, stretching from Warwick through the eastern half of Erving, to Wendell, Shutesbury, and New Salem. Wendell's sparsely populated terrain contributes to the wildlife value offered by permanently protected forestland.

The Town of Wendell therefore has the potential for sustaining wildlife species that require interior forest habitat. Wildlife biologists consider the areas traversed by roadways to be fragmented and therefore to be removed from consideration as interior forest habitat. Large forest patches should be maintained with connecting greenways to the riparian corridors of streams and rivers. Protecting large forest patches also will help to protect the first and second order streams that feed the Millers River. This is especially relevant for Osgood, Mormon Hollow, and Whetstone Brooks, the most promising recharge areas for Wendell's potential drinking water supply wells.

The Connecticut and Millers Rivers play a dual role for the region's wildlife. Riparian corridors often contain a greater degree of species diversity than any other portion of the landscape. The rivers also serve as important regional migration corridors. In 1996 the Conte Refuge sponsored a survey of migratory birds along the Connecticut River that revealed that 133 species, mostly woodland species, use the riverside habitat as a migratory corridor (Silvio O. Conte National Fish and Wildlife Refuge; 1997). The Natural Heritage and Endangered Species Program considers the riparian areas along the Millers and Connecticut Rivers as critical habitats for endangered, rare, threatened species, or those of special concern. Finally the rivers provide habitat for native freshwater fish as well as anadromous fish species.

⁷ Natural Heritage & Endangered Species Program (NHESP) and The Nature Conservancy, *Biomap2: Conserving the Biodiversity of Massachusetts in a Changing World*, November 2010. Data layers provided by NHESP.

Forests have always been known to play an important role in providing habitat for many plant and wildlife species. Throughout the 1970s and mid-1980s, it was commonly thought that New England forests lacked the diversity of stand age classes that existed in the earlier part of the century due to the presence of many old fields. One of the ways used to create more acres of young forest was by clear cutting trees in small patches throughout a woodland. Foresters considered this to be a choice treatment for producing early successional habitats within a managed woodland. Periodic heavy logging of forestland can also create early successional habitats.

The Massachusetts Division of Fisheries and Wildlife (DFW) uses a percentage of the income derived from hunting and fishing licenses for the purchase of wildlife habitat and important research into wildlife management. On some of their properties the DFW reclaims old fields with large brush cutting machinery for the purpose of creating habitats for wildlife that require young tree and shrub communities common to early successional landscapes. The species that inhabit these early successional landscapes include common game species targeted by hunters: ruffed grouse, whitetail deer, rabbit, and pheasant.

Beginning in the late 1980s, new information highlighted the importance, and relative scarcity, of interior forest habitats. Combined with a growing awareness of the indirect negative impacts of forest fragmentation from development, large forest blocks began to rise in importance in the eyes of the forest conservation community. Hence, there was a shift in attention away from the patch cut as the ideal wildlife habitat treatment for all occasions. It was replaced with the goal of protecting large blocks of contiguous forest.

NHESP encourages protection of large contiguous forest blocks and coordinated efforts between communities as the best opportunities to maintain populations of species and limit species loss from Town. Even with so much of Wendell being in the Wendell State Forest and the Audubon Sanctuary, there are fragments that if connected to other pieces would provide better habitat, according to Swain.

Wildlands and Woodlands: A Vision for the Forests of Massachusetts published by Harvard Forest in 2005 and updated in 2010 advocates a balance of both wildland reserves and managed woodlands. They suggest that wildland reserves should be large areas of 5,000 to 50,000 acres situated primarily on existing public lands selected to protect landscape level patterns, biodiversity, water supplies, old growth forests, opportunities for scientific study, as well as educational, recreational, and spiritual experiences. It suggest that a much larger area of managed woodlands can support the biodiversity of the wildlands, enable sustainable resource production, support life sustaining ecosystems such as productive soils, clean air, or flood control, as well as opportunities for education, recreation, and spiritual experience. Ongoing regional conservation efforts through forums such as the NQRLP have incorporated and continue to build on these ideas.

Careful timber harvesting as part of a forest management plan can provide a landowner with periodic income with the least amount of damage to the residual stand. Harvesting the best trees and leaving the rest without concern for future generations of trees within a stand is termed 'high grading'. It is in effect worse than clear cutting in some ways because the trees that are left to

help create the next generation are often inferior in form and health. On a small scale this practice may be considered as very damaging to the forest and wildlife. However, on a landscape scale, infrequent, poor forest harvesting practices may simply increase the diversity of forest conditions across tens of thousands of acres.

Residents with an interest in enhancing wildlife habitat on their property may wish to consult the *Landowner's Guide to Wildlife Habitat: Forest Management for the New England* at the recommendation of Wendell resident David Richard who is a managing forester for DCR. The authors, who include four U.S. Forest Service wildlife experts from Amherst and Durham NH, describe the book as “a ‘how to guide’ to forest wildlife habitat enhancement for private forest landowners and managers whose goals are primarily concerned with the non timber values of their land.” The authors stress the importance of early successional habitat to many species of wildlife and note that “for the first time since European settlement, early successional species are declining across eastern North America, and especially in New England.” They recommend enhancement of early successional habitats near cropland, old fields, orchards, and other open places and offer detailed information on the food values of a variety of plants.

It is impossible to predict how different habitats and vegetation types will shift across the landscape over time. Wendell is part of a much larger region with the Quabbin Reservoir being a significant part. Overall it is probably less important to be concerned with the landscape-level impact of forest cutting, than with how development fragments the edges of the Town's significant contiguous forests. If timber harvesting were very common throughout the region, but infrequently seen in Wendell, there would likely be a diverse range of immature and mature forests of various species, compositions, and ages, while the Town's forests would be more homogenous. However, if the opposite were true, the lack in forest stand diversity across the landscape would ultimately impact the numbers, variety, and species of the wildlife that are found in Wendell. Of course, changes to a forest's structure, age, and species composition occur through natural disturbances like hurricanes, ice storms, and fires.

The Connecticut and Millers Rivers have native freshwater fisheries and are being stocked with Atlantic salmon. American shad, blue-black herring, and shortnose sturgeon spawn within the local stretch of the Connecticut River. Historically, the Millers River has supported natural populations of salmon and trout, but due to the contamination by industrial and domestic wastes throughout this past century, the cold-water fisheries were eliminated in the lower stretches of the river (Millers River Advisory Board; 1983). Within the past few years Atlantic salmon restoration work has been accomplished each spring in the Millers River, and trout are stocked in various water bodies throughout the watershed (Department of Environmental Protection; Rojko personal communication; 2000).

The Massachusetts Division of Fisheries and Wildlife stocks a variety of trout species (non-native rainbow, eastern brook, and brown) for sport fishing in the Connecticut and Millers Rivers. Resident fish species in the Connecticut River include walleye, channel catfish, northern pike, small and largemouth bass, and pickerel.

Anadromous fish species (fish that are born in freshwater, migrate to salt water where they mature, and then return to freshwater to spawn) include striped bass, sea lamprey, blue-black

herring, American shad, Atlantic salmon and shortnose sturgeon. The river also contains a catadromous species of fish (fish that live in freshwater but return to saltwater to spawn), the American eel. The Silvio O. Conte National Fish and Wildlife Refuge and Connecticut River Atlantic Salmon Restoration Commission, both part of the US Fish and Wildlife Service, and nonprofit organizations like the Connecticut River Watershed Council and The Nature Conservancy are working to restore migratory fish to the Connecticut River and its tributaries.

Unfortunately dams on the Connecticut River and its tributaries threaten many species, especially Atlantic salmon, blue-black herring, and American shad by blocking fish passage and altering natural flows. During spawning season fluctuating water releases sweep away fish eggs and larvae. Dams also have a detrimental effect on young fish and place stress on older fish that must constantly alter their feeding and resting areas due to habitat changes resulting from fluctuating flows. Fish may be killed by turbines or stranded in isolated pools when high flow releases recede.

The construction of fishways at key points on the Connecticut River has reduced some of the harmful effects of dams. Regular stocking has led to marginal populations of Atlantic salmon and increased populations of American shad. Lamprey eel numbers have also increased significantly which indicates improving water quality throughout the Connecticut River watershed and more efficient fish passage installations (Franklin County Planning Department; 1990). Fisheries in the Massachusetts portion of the Connecticut River watershed are also threatened by sedimentation, erosion, toxicity, bacterial contamination, elevated stream temperatures, bioaccumulation, and low flow due to damming for hydroelectric operations (Connecticut River Forum; 1998).

E.4 Rare, Threatened and Endangered Species

There are several Priority Habitat areas in the Town of Wendell that are important to the conservation of a variety common and rare species. Priority Habitat is based on the known geographical extent of habitat for all state-listed rare species, both plants and animals, and is codified under MESA. Estimated Habitats are a sub-set of the Priority Habitats and are based on the geographical extent of habitat of state-listed rare wetlands wildlife and is codified under the Wetlands Protection Act, which does not protect plants.⁸ These Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife are located in Wendell State Forest, a roughly circular area of 3/8 miles radius from the intersection of Damon Camp Road and Laurel Drive; land all along Whetstone Brook; and along the Millers River in the Town of Wendell. According to the Mass. Division of Fisheries and Wildlife, most of the known rare species in the Town of Wendell are wetland species. Turtles, salamanders, and freshwater mussels are among a variety of species that can be found in both the Millers River and its tributary, Whetstone Brook. Marshes along the backwaters of both rivers support many other species. Also, Wendell State Forest has bogs that provide habitat for several rare species.

⁸ Department of Fish & Game, Mass Wildlife, Division of Fisheries & Wildlife, Natural Heritage and Endangered Species Website.

Several beaver ponds in the Town support colonies of Great Blue Herons, the largest member of the heron family. This wading bird may grow to four feet tall and has a wingspan of five and one half to seven feet. Although Great Blue Herons are considered secure and are no longer listed as rare and endangered, the rookeries of heron are tracked by the Division of Fish and Wildlife and are considered good environmental indicators. In Massachusetts, typical nesting areas for herons are beaver meadows and sites where beaver activity has flooded the area and created dead tree stands. In Wendell, rookeries are located in Whetstone Wood Wildlife Sanctuary and in a swamp along Mormon Hollow Brook (southeast of Perry Farm Road), but it is not expected they will always have herons, since the colonies move as the dead trees in which they nest decay and fall. Within the last thirty years, the reintroduction and restoration of beaver populations, accompanied by commensurate increases in the habitat they create, resulted in favorable conditions for the growth of the Great Blue Heron populations.

The Water Shrew (*Sorex palustris*), a Species of Special Concern that is rarely observed in the state was last sighted in Wendell in 2001. The water shrew is the largest long-haired shrew in New England. It measures 5.7-6.6 inches in length, with its long tail accounting for more than half of its total length. The unique feature of the Water Shrew is its big “feathered” hind foot. The third and fourth toes of the Water Shrew are slightly webbed, and all toes, as well as the foot itself, have stiff hairs along the sides. These animals show slight seasonal color variations. In winter it is glossy grey black above tipped with silver and silvery buff below. In summer its fur is more brownish above and slightly paler below, with less of a frosted appearance. The spring molt occurs during late May and early June.

This species is especially adapted for semi-aquatic life. Along with its large webbed hind feet, its fur or pelage is so dense that it is nearly impenetrable to water and traps air bubbles that shed wetness and enhance buoyancy. This trapped air also allows the Water Shrew to exhibit “water-walking” behavior. The Water Shrew is seldom found more than a few yards from water and prefers to be near heavily wooded areas. It may be found near beaver lodges and muskrat houses in winter. Because its reclusive habits make it difficult to encounter by chance, little is known about its actual distribution and abundance in the state. Between the years 1978 and 1994 there were only five sightings of the Water Shrew in the state at four locations including New Salem.

There are many threats to the Water Shrew such as fragmentation of their habitat, which leaves little opportunity for their movement, even in relatively small areas. Warming and siltation of headwater streams that result from logging, clearing for agriculture, and road building; acid rain, and potentially the introduction of new predators such as small-mouth and large-mouth bass.

The Triangle Floater (*Alasmidonta undulata*), a Species of Special Concern, was last observed in Wendell in 1997. The shell of this freshwater mussel is inflated with umbos extending well above the hinge line. A tightly curved ventral margin makes the length to height ratio roughly equal. The periostracum may be yellow to golden brown with rays, turning dark brown or black with age. There is one chunky pseudocardinal tooth in the right valve, two in the left valve. The lateral teeth are vestigial. Nacre color is bluish-white with an occasional salmon or pink wash. This species demonstrates no particular habitat preference across its range, having been collected from silt/sand in slower moving waters, gravel/sand in riffles and runs, and from crevices in bedrock. The triangle floater may be found gravid throughout the year.

The New England Bluet Damselfly (*Enallagma laterale*), a Species of Special Concern seen in Wendell in 2002, is a small semi-aquatic insect in the order Odonata, suborder Zygopt (the damselflies) and in the family Coenagrionidae (pond damsels). Like most damselflies, New England Bluets have large blue eyes on the side of the head, short antennae, and four heavily veined wings that are held folded together over the back. The New England Bluet averages just over an inch in length and have blue abdominal segments with black markings on some segments. They have been found in a variety of lentic habitats, including swampy open water in north-central Massachusetts, though they are most common at coastal plains. Natural upland habitats near ponds are important for them as like many damselflies, they spend several days or more away from the water maturing. The major threat to the New England Bluet is likely destruction of its breeding habitat from construction, or run-off from roads and sewerage.

The Spine-Crowned Clubtail (*Gomphus abbreviatus*), listed as Endangered by the state, are large, semi-aquatic insect that were seen in Wendell in 2005. They are members of the family Gomphidae, a large diverse group of dragonflies. Clubtails are named for a lateral swelling at the tip of the abdomen that produces a club-like appearance. Club tails are further distinguished from other dragonflies by their widely separated eyes and wing venation characteristics, and behavior. Spine-Crown Clubtails are dark brown/black dragonflies with pale to bright yellow markings on the body and green eyes. Adult Spine-Crowned Clubtails range in length from 1.3 to 1.4 inches with a wing span averaging 2.6 inches. They inhabit large streams and rivers with silty and sandy bottoms. The nymphs are aquatic, burrowing just under the sediment in the river bottom, and the adults inhabit the riparian areas, forested uplands, and fields. Thus upland border of the river systems are crucial to their well being as they are critical for feeding, resting, and maturation. They are imperiled by the wakes of high speed watercraft, but low-level recreational use such as canoes likely has little impact on their populations.

The Arrow Clubtail Dragonfly (*Stylurus spiniceps*) is a Threatened Species that was also sighted in Wendell in 2005. Also a member of the Clubtails The Arrow Clubtail is in the genus *Stylurus*, the so-called “hanging clubtails”, a group characterized by having moderately flared clubs and relatively short legs. They typically perch high in tree tops on the upper surface of the leaves, in a vertical position. Arrow Clubtails are brownish with pale yellow to green markings on the body and bright green eyes. They range in length from 2.1 to 2.55 inches with a wingspan averaging about 2.75 inches in length. They are elusive and little is known about their life history. The aquatic nymphs spend at least a year, probably more, maturing, undergoing several molts during this period. Soon after they cast off their skins and emerge as adults, they wings harden and they fly off to seek refuge of adjacent uplands.

Several species occurring in Wendell have been delisted since the Wendell Open Space and Recreation Plan was last updated in 2002. The Spotted Turtle (*Clemmys guttata*), the Spring Salamander (*Gyrinophilus p. porphyriticus*), and the Four-toed Salamander (*Hemidactylium scutatum*), have been determined to be more abundant and better protected than they were previously thought to be, according to Swain. All of these species are found in wetlands.

The Spotted Turtle, known to occur in Wendell, was once one of the most common turtles in Massachusetts. The spotted turtle is a member of the largest turtle family, (Emydidae). It is a relatively small turtle (three to five inches). It gets its name from the bright yellow circular spots

that dot its smooth, black carapace (upper shell). Spotted turtles inhabit a variety of wetland habitats in Massachusetts, including forested and non-forested types. They dwell in marshy meadows, bogs, small ponds and brooks, ditches, and other shallow unpolluted bodies of water. They are also found in Red Maple and Atlantic White Cedar Swamps and woodland vernal pools. The greatest threat to the spotted turtle is development and habitat fragmentation. Increased residential development, construction of new roads, alteration of wetlands, and destruction of upland habitats all severely impact the spotted turtle. Protecting wetland, upland corridors between wetlands and potential nesting areas are vital to the continued existence of this reptile.

The Northern Spring Salamander, sometimes called the Purple Salamander, it is the largest of the lungless salamanders in New England. The adult length is five to eight inches (5-8 in.). The habitat of the Northern Spring Salamander is clear, cold, alkaline or slightly acidic waters of springs, streams and lakes, and logs or stones under which to hide. It will not survive in warm or muddy waters or in streams that have been polluted by commercial wastes. The principal threat of the Northern spring salamander is degradation of its cold-water habitats. Road and agricultural run-off and siltation from construction and logging must be discouraged. Erosion into streams that would bury rocks, logs, etc., that provide cover should also be avoided as well as timber harvesting in known habitats, due to increased sunlight causing thermal pollution of needed cold water habitat.

The Four-toed Salamander, known to occur in Wendell, is the smallest salamander found in Massachusetts and is easily identified by three distinctive characteristics. As its name implies, this salamander has only four toes on the hind feet. It also has a very distinct constriction at the base of its tail and its belly resembles bright white enamel speckled with black. The females range in length from 2.8 to 3.5 inches, whereas the males are slightly smaller (2-3 inches). The breeding habitat of the four-toed salamander in Massachusetts is in bogs, swamps dominated by red maple and Atlantic White Cedar, vernal pools, and perennial wetlands with sphagnum moss. As a result of their preference for wetlands dominated by sphagnum, they are quite tolerant of acidic conditions. The greatest threat to the four-toed salamander is habitat destruction resulting from road construction, development, and timber harvesting in and around boggy wetlands, peatlands, and forested wetlands. Given its preference for nesting sites in bogs with sphagnum moss, every effort must be made to protect the natural state of the bog areas throughout the state.

Table 4-6: Rare Wildlife Species Found in the Town of Wendell

Common Name	Taxonomic Group	Scientific Name	MESA Status	Federal Status
Adder's-tongue Fern	Vascular Plant	<i>Ophioglossum pusillum</i>	T	1931
New England Bluet	Dragonfly/Damselfly	<i>Enallagma laterale</i>	SC	2008
Pale Green Orchis	Vascular Plant	<i>Platanthera flava var. herbiola</i>	T	1936
Spine-crowned	Dragonfly/Damselfly	<i>Gomphus abbreviatus Clubtail</i>	E	2004
Triangle Floater	Mussel	<i>Alasmidonta undulata</i>	SC	1997
Water Shrew	Mammal	<i>Sorex palustris</i>	SC	2001

Source: Division of Fisheries and Wildlife; 2010.

E.5 Analysis

Wendell is close to a huge wildlife source, the Quabbin Reservoir. To its north, the Millers River is a corridor for both fish and terrestrial and amphibious wildlife. Large blocks of forestland are protected from development and several major stream corridors provide habitat and recharge to streams and potential future drinking water supplies. Linkages and connections are important to consider as Wendell plans for its current and future open space and recreation resources. Recreational trails may be inappropriate for some areas due to proximity to sensitive areas containing erodable soils and/or rare and endangered species. On the other hand, trails laid out with care and sensitivity can be a popular basis for the protection of linked parcels of open space that in turn serve area wildlife.

F. SCENIC RESOURCES AND UNIQUE ENVIRONMENTS

Wendell is distinguished from neighboring towns by unique and special places that its residents know well. This section identifies scenic resources and special environments that most residents agree represent the Town's unique essence. Rivers, mountains, wetlands and village centers comprise the physical markers of our sense of place distinguishing Wendell from its neighbors. Wendell's scenic landscapes are also important by virtue of special wildlife habitats. Our purpose in inventorying scenic resources and unique natural environments is to provide a basis for prioritizing our efforts at protecting them.

For this reason the following section includes information about the different values associated with each scenic resource and natural environment and also demonstrates the areas where there are multiple values represented in one landscape. Those landscapes that contain, for example, scenic, wildlife, and cultural values may be seen as having a higher priority for protection than a landscape that contains only one value.

A few of these scenic resources also include significant historic structures and landscapes. This historical information is included and is based on a formal landscape survey done in 1992. The 1992 Franklin County Rural Historic Landscape Preservation Plan Report was created by the Franklin County Commission (now the Franklin Regional Council of Governments). It describes the status of historic landscapes in the region, the historic context that was used in its determination, and the methodology used in rural historic landscape reconnaissance. It distinguishes between the types of landscapes assessed (*agricultural, community development, recreational, conservation, industrial, transportation, scientific, religious, and engineering*), identifies in general terms the locations of rural historic landscapes in each town, and provides examples of direct and indirect preservation strategies.

The methodology used for identifying significant historical landscapes was based on the National Park Service criteria, including area of significance, period of significance, and historical integrity. The National Park Service classifies landscapes into four different categories: landscapes that reflect major patterns of a region's history (e.g. agricultural landscapes), landscapes that are associated with historically significant individuals (e.g. institutional grounds

and buildings), landscapes that are important due to their design or physical characteristics (e.g. an 18th century Colonial Period Connecticut Valley rural farm), and landscapes that yield or have the potential of yielding significant information on pre-history or history (e.g. a native American encampment site).

Table 4-7 lists different landscapes and sites and describes their scenic, natural/ecological, and cultural/historical values. This list represents a summary of resources reported in the 2002 Wendell Open Space Plan, the 1990 Community Vision of the Future, and other planning documents used throughout this Open Space and Recreation Plan. The Scenic Resources Map at the end of this section shows the overlap of these scenic, ecological, and cultural values where different hatching patterns are layered. The numbers in Table 4-7 correlate with the map showing the location of each scenic and unique environmental feature in Wendell. The text that follows the table addresses the common themes associated with the greatest concentration of values as displayed in both the map and the table. For example, the relationship between the high elevation points and the wildlife habitat values of these areas is important. The wildlife value is in part due to the presence of large contiguous blocks of undisturbed forest that are more prevalent along the region’s higher elevation plateaus than anywhere else.

In a few cases, the landscapes are described in the table as being a *Significant Historical Agricultural or Conservation Landscape*. When these words are in italics, it means that this landscape has been documented as a significant historical landscape based on the National Park Service standards, which are different than those applied by the Wendell Open Space Committee.

In the far right column of Table 4-7, the landscape’s protection status is estimated. For the purposes of this Open Space Plan, a landscape is defined as a land area with a particular land use pattern (farmland), or a physiological landform (monadnock) distinguishable from adjoining areas. Often ownership patterns do not coincide with the boundaries of a landscape. A ridgeline may have both protected and unprotected sections. Landscapes that contain parcels in the Ch. 61, 61A, or 61B programs are important because the Town has the right of first refusal to purchase these properties for 120 days from the point at which the owner has signed a purchase and sale agreement. This right may be passed on to a third party, such as a conservation land trust.

Table 4-7: Significant Scenic/Ecological/Recreational/and Historic Landscapes/Environments in Wendell

Map #	Scenic Resource	Ecological/ Geological Value	Recreational Value	Historical Value	Protection Status
<i>Stream Corridors</i>					
1	Millers River	NHESP Priority Habitat for Rare Species: Unusual Natural Communities	High		Much within the State Land on the Wendell side of the Millers River is Partially Protected with the Rivers Protection Act
2	Whetstone Brook	Rare and Endangered Habitat			Mostly Protected within the Whetstone Wood Wildlife Sanctuary and Wendell State Forest
3	Osgood Brook	Associated Aquifer			Protected within the Wendell State Forest

Map #	Scenic Resource	Ecological/ Geological Value	Recreational Value	Historical Value	Protection Status
4	Mormon Hollow Brook	Associated Aquifer			Partially Protected within the Wendell State Forest
5	Lyons Brook and Scenic Falls (unprotected)	Wildlife Habitats			Partially Protected on Wendell side by DCR
6	West Branch of the Swift	Within Quabbin Watershed			Protected through the Watershed Protection Act, as well as by DCR and DFW
7	Plympton Brook	Wildlife Habitats			Protected within Wendell Wildlife Area and adjacent to Ch. 61 land
Ponds					
8	Ruggles Pond	Unusual Natural Communities	High	<i>Significant Historical Recreation/Conservation Landscape</i>	Protected within the Wendell State Forest
9	Wickett Pond	Wildlife Habitats and it is the only non-human made pond in Wendell		<i>Significant Historical Recreation/Conservation Landscape</i>	Protected within the Wendell State Forest
10	Fiske Pond	Unusual Natural Communities	High (Potential)		Protected by Town as Fiske Pond Conservation Area
11	Bowens Pond	Wildlife Habitats			Surrounded by Ch. 61 lands
12	MacAvoy's Pond	Wildlife Habitats			Unprotected
13	Porter's Pond (a.k.a. Twin Ponds)	Wildlife Habitats			Unprotected
14	Zak's Pond	Wildlife Habitats			Unprotected
15	Stillwater Ponds	Wildlife Habitats			Surrounded by Mass. Division of Fisheries and Wildlife lands
Swamps					
16	Plain Road Swamp	Wildlife Habitats/Heron Rookery			Permanently Protected by Mass. Audubon Society
17	Catamount Swamp	Wildlife Habitats			Partially Protected by DCR
18	Farley Road Swamp east of Perry Farm Road	Wildlife Habitats/Heron Rookery			Partially Protected within Wendell State Forest
19	Sibley Swamp	Wildlife Habitats/ Heron Rookery			Partially Protected within DCR lands
20	Swamps along West Branch of the Swift east of Cooleyville Road	Wildlife Habitats			Protected through the Watershed Protection Act, DCR and DFW
21	Wetlands within Wendell State Forest	NHESP Priority Habitat for Rare Species; Unusual Natural Community; Wildlife Habitat		High Recreational Value	Permanently Protected
Recreational Resources					
22	Bear Mountain	Geologic -Monadnock Ridgetop; Wildlife Habitats	High	Recreational Value and <i>Significant Historical Recreation/Conservation Landscape</i>	Permanently Protected
23	M&M Trail		High	Major Recreational Trail System	Partially Protected within Wendell State Forest
24	Wendell State Forest	Wildlife Habitat	High	<i>Significant Historical Recreation/Conservation Landscape</i>	Permanently Protected

Map #	Scenic Resource	Ecological/ Geological Value	Recreational Value	Historical Value	Protection Status
<i>Cultural Areas</i>					
25	Wendell Town Common/with Northeast Long Range View			Significant Historical Agricultural/Community Development Landscape Historical Cross-road Village Center	National Historic Register/ Protection Status Unknown
26	Old Stoneville			Historic Industrial Heritage Site	National Historic Register/ Unprotected
27	Mormon Hollow Historic Area			Historic Village Site / Mill Foundation	Unprotected
28	Farley Bridge and Views of Millers River			Historical Structure	Unprotected
29	Town Pound on Montague Road opposite the intersection with Bullard Pasture Road			Historical Structure	Town-Owned/ Unprotected
30	Wendell Center Cemetery			Historical Site	Permanently Protected
31	Locke's Village Cemetery			Historical Site	Permanently Protected
32	Small Pox Cemetery			Historical Site	Permanently Protected
<i>Scenic Roads</i>					
33	Wickett Pond Road			Significant Historical Agricultural Landscapes	Partially Protected by Wendell State Forest
34	Bullard Pasture Road		Discontinued portion Used for hiking & skiing	Cellar hole	Discontinued portion Protected by Div. Of Fisheries & Wildlife
35	West Street				Unprotected
36	Locks Hill Road				Partially Protected by DFW
37	Cooleyville Road				Unprotected
38	Jennison Road			Significant Historical Agricultural Landscapes	Unprotected
39	Bear Mtn. Road		Discontinued portion Used for hiking & skiing		Permanently Protected by DCR
40	Woods roads off Stone Road and Depot Road				Partially Protected
41	Hemmiway Road				Permanently Protected by DCR
42	Rockwell Hill Road				Potentially discontinued/ Partially Protected by DCR land
43	Montague Road				Partially Protected by Wendell State Forest
44	New Salem Road				Partially Protected by Whetstone Wood Wildlife Sanctuary and DCR
45	Gate Lane				Partially Protected by Wendell State Forest and DCR
46	Rush Road				Partially Protected by MAS and DCR lands
47	Lockes Village Road/Scenic View of McAvoy's Pond				Partially Protected by DFW Lands/View, Unprotected
48	Old Egypt Road		Discontinued Used for hiking &skiing		Partially Protected by Wendell State Forest

Map #	Scenic Resource	Ecological/ Geological Value	Recreational Value	Historical Value	Protection Status
49	Wendell Depot Road/Long Range View at Common				Unprotected to Stone Road/Mostly Protected from Stone Road to the Depot
50	Stone Road				Mostly Protected by Wendell State Forest
51	Farley Road/Long Range View				Partially Protected by Wendell State Forest
52	Mormon Hollow Road/Long Range View westward				Unprotected
53	Davis Road/ Long Range View westward				Partially Protected by Wendell State Forest
<i>Unusual Geological Features</i>					
54	Jerusalem Road Ledge also has a Scenic Long-range View				Protected by Wendell State Forest
55	Whales Head				Protected by Wendell State Forest
56	Steep Hill Off Wendell Depot Road				Partially Protected by DCR
<i>Unusual Natural Communities</i>					
57	High Energy Riverbank -Millers River	Unusual Natural Community			Permanently Protected abutting State Forest and DFW Land
58	Floodplain Forest - Millers River	Unusual Natural Community			Permanently Protected abutting State Forest and DFW Land
59	Kettlehole Level Bog - Wendell State Forest	Unusual Natural Community			Permanently Protected, State Forest
<i>Significant Historical Agricultural Landscapes</i>					
60	J. C. Holston Property, Depot Road			<i>Significant Historical Agricultural Landscapes</i>	Unprotected
61	J. Wyman Property, Wickett Pond Road			<i>Significant Historical Agricultural Landscapes</i>	Unprotected

Source: Franklin County Rural Landscape Preservation Plan Report, Franklin County Commission; 1992. Community Vision of the Future, Conway Design Associates; 1990; Wendell Open Space and Recreation Plan, 2002.

Several themes emerge from both Table 4-7 and the Scenic Resources Map. While many of the places listed on the table and map are protected by the state or the Audubon Society, a number of Wendell’s scenic resources and unique environments remain unprotected. Most of the banks of the Millers River are protected by the DFW, but neither of the access points to the river from Wendell is protected. While the Town’s largest ponds are protected, several smaller ponds are privately owned and unprotected and are a majority of the town’s *Significant Historical Agricultural Landscapes*. Many of the Town’s historical sites including Old Stoneville, Mormon Hollow Historic Area and the Town Pound remain unprotected. While much of the M&M Trail is protected, some areas are not. The Scenic resources and valued natural environments naturally fall into several categories as described in the following sections.

F.1 Scenic Water Resources

Scenic water resources for the Town of Wendell are shown on the Scenic Resources Map at the end of this section.

F.1.1 Rivers and Brooks

Millers River and its Tributaries

The Millers River is Wendell's largest and most historically significant river, providing whitewater boating and fishing. Tributaries of the Millers River include Whetstone Brook, Osgood Brook, Mormon Hollow Brook and Lyons Brook. Whetstone Brook is particularly scenic and flows through both Wendell State Forest and Whetstone Wood Wildlife Sanctuary for most of its length. Whetstone Brook is remote and possesses numerous wetlands and beaver ponds making the area an excellent wildlife habitat. Whetstone Wood Wildlife Sanctuary protects most of the headwaters for Osgood Brook, which flows for much of its length within Wendell State Forest. This stream provides scenic views along Wendell Depot Road, which parallels it for most of its course to the Millers River. Both Mormon Hollow Brook and Lyons Brook flow out of ponds located within Wendell State Forest and flow for most of their length within the Forest. Lyons Brook is part of the Wendell/Montague Town line. It also contains Lyons Brook Falls, considered one of the most scenic falls in Wendell.

West Branch of the Swift River

The two headwater streams of the West Branch originate respectively near the Town Salt Barn on Lockes Village Road, and near private property on Morse Village Road. The West Branch flows southeast into Shutesbury. The beaver ponds located along the West Branch provide excellent wildlife habitat. The Division of Conservation and Recreation regulates land use within four hundred feet of all tributaries in this sub-basin. All the land within this sub-basin drains into the Quabbin Reservoir. Therefore, Wendell's treatment of these headwater areas directly affects water quality in the Quabbin reservoir.

F.1.2 Special Ponds

One of two ponds lying within Wendell State Forest, Ruggles Pond contains nineteen (19) acres and is especially picturesque. The pond is bordered by a scenic shrub swamp and marsh providing excellent habitat for wildlife viewing. This shallow pond was created when the Civilian Conservation Corp rebuilt a mill dam at the foot of an abandoned field.

The second pond lying within Wendell State Forest is Wickett Pond, about thirty (30) acres in area, surrounded by hardwood forest, and reached by (unpaved) Wickett Pond Road. This natural pond features very deep peat beds, and is nearing the end of its natural succession process, making it uniquely beautiful and ecologically dynamic.

Fiske Pond, created by damming Fiske Brook, flows south from Wendell State Forest, is noted for its natural beauty and formerly was a favored recreation spot for residents. Of ten (10) acres in surface area, it is an ecologically special place, constituting a rare example of 'fusion' between Coastal Sand Plain and Western Prairie vegetation types. Located near West Road and Lockes

Village Road and permanently protected by the Town as the Fiske Pond Conservation Area in 2005, it is surrounded by stands of large white pine and eastern hemlock, and there is a ten-acre marsh where Fiske Brook enters the basin.

There are several other water bodies noted for their scenic qualities. Bowens Pond is located on Wendell Depot Road and is surrounded by hardwood forest and some open grassland. This pond once furnished water to run a grist mill whose remains are still visible below the pond's dam east of Wendell Depot Road. MacAvoy's Pond and Stillwater Ponds were created by a series of small dams. Privately owned and unprotected, MacAvoy's Pond is a 15-acre lake with swampland on the northeast shore. The Stillwater Ponds, located along Lockes Village Road, are surrounded by Massachusetts DFW lands. An attractive former mill pond of several acres, bisected by Jennison Road near the New Salem town line, privately owned and unprotected, is Porter's Pond or Twin Ponds, which can be circumambulated by a path that also connects to a woods trail. Zak's Pond is a privately owned unprotected pond located along Plympton Brook between MacAvoy's Pond and Stillwater Ponds. There is a scenic waterfall at the site where Lyons Brook empties into the Millers River (just before the railroad). There is also a scenic pond on private property owned by the Diemand Farm, located on Mormon Hollow Road.

F.1.3 Wetlands

Wendell residents consider all of our wetlands to be of scenic value, enjoyed for bird watching, nature walks, and hunting. Important forested swamps in Wendell include Plain Road Swamp, Catamount Swamp and a large unnamed swamp bordering Farley Road east of Perry Farm Road. Smaller swamps are common along streams and in low-lying areas that form the headwaters for many of the small streams in Wendell. Important smaller swamps include the scenic fifteen-acre Sibley Swamp located on DCR land off Rockwell Hill Road, unnamed swamps near Wickett and Ruggles Ponds in Wendell State Forest, swamps along the West Branch of the Swift River east of Cooleyville Road, and swamps bordering Whetstone Brook.

F.2. Resources Associated with Large Blocks of Protected Contiguous Forest

F.2.1 Whetstone Wood Wildlife Sanctuary

Whetstone Wood Wildlife Sanctuary is located in the eastern section of the Town of Wendell. Owned by Massachusetts Audubon Society, it comprises a total of 1,940 acres with 1,648 acres in Wendell with the remaining acreage in the towns of Orange and New Salem. This includes about 20 acres in New Salem protected by conservation restrictions. The Sanctuary contains various habitat types including mixed hardwood and softwood forests, ponds and wet meadows, open fields and stream-side thickets. Many varieties of plant and wildlife can be found in Whetstone Wood. Nesting sites, called heronries, of the Great Blue Heron, exist in Whetstone Wood. The Sanctuary also protects a significant portion of the headwaters of Whetstone Brook and Osgood Brook, major tributaries of the Millers River. Portions of Whetstone Wood Wildlife Sanctuary are listed as Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife by the Natural Heritage and Endangered Species Program, Mass. Division of Fisheries and Wildlife.

F.2.2 Wendell State Forest, Bear Mountain, and the Metacomet-Monadnock Trail

Wendell State Forest, managed by the DCR, is our most notable scenic landscape. Located south of the Millers River, Wendell State Forest covers 7,900 acres of scenic forested hills, with streams, ponds and wetlands, and includes an extensive trail system with connection to the Metacomet-Monadnock Trail. Wendell State Forest lies within the viewshed of the Millers River and includes some steep slopes adjacent to the river. Land purchases for Wendell State Forest began in the 1920s and continue today. Some park development at Ruggles Pond, and most of its road system, were built by the Civilian Conservation Corps (CCC) in the 1930s.

Wendell State Forest includes Bear Mountain, an area of valuable forest land, excellent wildlife habitat and several streams including a brook with a cascading waterfall. Thompson Road, which runs from Farley Road to Old Farley Road, passes near the peak of Bear Mountain. At this location there is a stand of large white pine trees and the remains of a cabin. From here, one can hike west through the woods to the top of Bear Mountain, whose summit view is blocked by large trees.

Approximately three miles of the Metacomet-Monadnock Trail (M&M Trail) pass through Wendell State Forest. The M&M Trail is 117 miles long, beginning at Hanging Hills in Meriden, Connecticut and continuing to Mount Monadnock in New Hampshire. The trail corridor links several state forests including Montague, Wendell, Erving, Northfield, Mount Grace, and Warwick State Forests. Local hikers can access the M&M Trail by way of a trail that connects to the Fiske Pond Loop Trail.

F.3. Significant Cultural, Archeological, and Historical Sites and Landscapes

F.3.1 Cultural and Historical Sites

Wendell Town Common

Located near the geographic center of the Town, the Wendell Town Common Historic District is a well-preserved, rural village center, which is considered by residents as the heart of the Town of Wendell. It is also a documented *Significant Historic Community Development/ Agricultural Landscape* representing a typical crossroads village center. The Town Common Historic District encompasses approximately 26 acres and includes 24 contributing buildings, sites and objects comprising the historic, civic, commercial and residential core of Wendell. The Town's incorporation and the establishment of a meetinghouse on the Common in 1781 marked the beginning of the use of the Historic District as the civic center of the Town.

The Town Common is a roughly rectangular piece of open land bounded by Wendell Depot and Lockes Village Roads on the west and Center Street on the north, east and south, and bisected by Morse Village Road. The adjacent properties, Greek Revival residences and institutional buildings, generally face the Town Common. The boundaries of the Historic District generally follow property lines that conform to visual and natural boundaries. All buildings in the district are located close to the road. Several farmhouses are set on large parcels of twelve to seventy acres and have pastures extending behind. Most of the remaining buildings are on lots of

approximately one-quarter acre. All of the primary buildings, with the exception of the Wendell Senior Center, date to the late Federal-early Industrial periods. The Greek Revival Style predominates with individual examples existing of the Federal and Colonial Revival Styles. Residential construction around the Common was most intense during the 1830's and 1840's, when five new houses were built in the Greek Revival Style. The most substantial of these Greek Revival houses is the Luke O. Leach House built ca. 1839 and shown as site A.5 in Table 3-1. Other significant buildings on the Common include the Baptist Church/Town Hall and the Central Congregational Church. The Town Hall/School House that later contained the Town Offices and Senior Center was destroyed following damage from a tornado in 2006 during construction of the new Wendell Free Library. The Wendell Senior Center, built in 1921 and of Colonial Revival/Shingle Style, is the only institutional building in the Historic District representing a style other than Greek Revival. The Wendell Town Common continues to retain its historic integrity and fulfills the criteria for the National Register of Historic Places at the local level.

Old Stoneville

Sitting directly opposite Stoneville, on the Wendell side of the Millers River, is the nineteenth century mill village site of Old Stoneville. Built in 1851, it was the location of J.E. Stone and W. Washburn's piano and billiard case factory. Due to the fact that it remains unaltered, Old Stoneville has been determined to be of great archeological value and is eligible for listing in the National Historic Register according to the U.S. Dept. of the Interior. This property is unprotected. Part of it is owned by the Town and part of it is privately owned.

Farley Bridge

The Farley Bridge, built in 1889, spans the Millers River at Farley. Built by the team of Dean and Westbrook, the bridge is a pin connected iron truss bridge. It is the only known example in Massachusetts to use the Phoenix Iron Company's wrought iron "Phoenix Columns". The bridge also retains its two richly ornamented nameplates. The Farley Bridge was economically important to both the Towns of Wendell and Erving. The Town of Erving had numerous manufacturing mills for which Town of Wendell supplied wood and the personnel to run the mills.

Town Pound

The Town Pound, constructed in 1846, is located on Montague Road opposite the intersection with Bullard Pasture Road. A round stone enclosure, it was used to contain stray animals.

Town Cemeteries

The Wendell Center Cemetery is situated on the Town Common and was established in 1782. It was associated with the Congregational Church and is still in use. A Victorian cast iron fence (pre-1871) with carriage gate and pedestrian gate extends along the Common side of the cemetery. While the grounds are well maintained, little attention has been paid to condition of older graves stones. Wendell is fortunate to live in close proximity to the Greenfield based Association for Gravestone Studies that offers a wealth of information on preservation techniques for historic cemeteries that could benefit many of the aging headstones.

The Locke's Village Cemetery, located on Jennison Road, contains an unusual earth covered vault as well as free stone wall. There are approximately 250 gravestones in this cemetery, most of which appear to be late 19th Century or 20th Century.

The Small Pox Cemetery was especially created to receive the bodies of those who died in the small pox epidemic in Wendell in March 1833. The cemetery also received the family members of those who died in the epidemic. Local oral tradition states the bodies were transferred to the cemetery from some holding place at night and that the cemetery was deliberately placed far from the center of town to avoid possible "contagion" from the corpses.

F.3.2 Archeological Sites and Landscapes

Mormon Hollow Historic Area

Located along Mormon Hollow Brook and unprotected, the Mormon Hollow Historic Area consists of a large number of nineteenth century and possibly eighteenth century foundations as well as a cemetery located on a cliff above the brook. The Mormons allegedly had a settlement here in the mid-nineteenth century. It is believed the foundations, one of which may have been a gristmill, may have been from this Colonial settlement. It is possible that the foundations were the homes of a known family, Charles Woods (died 1795) and Charles Woods, Sr. (1797) who are buried in the cemetery. In addition, there are 42 granite gneiss stones that could be burial markers. The foundations and stones are considered significant, as they are predominantly granite, most likely taken from the only outcropping of granite in the Town of Wendell, located at Bear Mountain.

F.3.3 Historical Landscapes

Wendell State Forest

The Wendell State Forest was established in 1921 as part of a statewide effort to reclaim cut-over land throughout the state. In 1933, the CCC, created by President Roosevelt, provided economic recovery employment to improve the forest and recreational resources of the country. In May of 1933, at the north end of Ruggles Pond, CCC Camp S-62 (Company 116) was established. Like most state forests in the early 1930's, Wendell was largely undeveloped and inaccessible by land. One of the first tasks of the CCC was constructing a network of truck trails, followed by a number of waterholes for fire suppression. Forestry work undertaken by the CCC included planting, forest stand improvement, trail maintenance, and pest control. The major recreational improvements were at Ruggles Pond, a former mill pond that had been in poor repair for years. The CCC dug out the pond to make it more useful for recreation, improved the fieldstone-faced concrete dam, repaired a fieldstone-faced bridge over Lyons Brook, built a dry-laid stone retaining wall, and several parking areas. The Ruggles Pond area is an outstanding example of CCC stonework with many different types of resources in one location. The camp closed in December 1937, and in 1938, the famous New England hurricane devastated extensive timber stands in the forest. Few changes have been made at the forest since that time other than construction of a new headquarters building on Montague Road at the western edge of the forest.

F.4 Scenic Roads

In many parts of Wendell, historic landscapes blend with scenic viewsheds. Scenic roads, which access these special places, overlap both. In 1974, the Town of Wendell designated all eligible roads as scenic pursuant to Chapter 40, Section 15C of the Massachusetts General Laws. Local scenic road designation provides limited protection to historic and scenic resources along local byways. Once designated, the Planning Board must give written approval before any repair, maintenance, construction, or paving of the road is allowed if that activity would involve the cutting or removal of trees, or the tearing down or destruction of stone walls in the public right of way. To obtain further protection under the Scenic Roads Act, the Town needs to adopt a local bylaw.

F.5 Unusual Geological Features

Jerusalem Road Ledge is a ledge outcropping in Wendell State Forest. It provides not only potential for geology study, but also an excellent view to the north and west including Mt. Greylock when weather permits. In addition, below the ledge is a small, protected valley with a reliable stream of fresh water. This area could have been an early Colonial farm site or settlement of native peoples.

Whales Head is a rock shaped like an elephant's head and is visible from Damon Camp Road. Also visible from the air is a hilltop shaped like a whale's head.

Mormon Hollow Road, near the junction of Farley Road, provides access to Mormon Hollow Brook. The ledge bottom of the brook and the ledge outcropping on the hillside are of interest for geologic study.

There is a steep unnamed hill off Wendell Depot Road visibly prominent from the Millers River Bridge. It has an elevation of one thousand and twelve feet (1,012 ft.) and is considered suitable for rock climbing.

F.6 Significant Scenic Views

Wendell's rugged terrain offers scenic views of forests and streams, but long-distance views are few because they are obstructed by trees. The available long-distance vista occur on Farley Road, which gives excellent views of the hills and valleys to the northwest, including the Northfield Mountain Pumped Storage Dam. Wendell Depot Road north of New Salem Road provides excellent views of Osgood Brook, which can be especially impressive during periods of heavy runoff. Within Wendell State Forest, from the top of the ledges on the easterly side of Jerusalem Road, there is a fine long-range view. From vantage points on the Town Common, both Mount Grace and Mount Monadnock can be seen.

Shorter views of interest abound along most of the roadways in the Town of Wendell. Some of the more scenic roads include Wickett Pond Road, Bullard Pasture Road, West Road, Locke Hill

Road, Cooleyville Road, and Jennison Road. Wickett Pond Road and Jennison Road have fields and old farm houses or foundations that represent historical land use patterns. The two properties on Jennison Road contain fields and historic structures. One is located on the corner of Old Stage Road and Jennison. Short and long-range views are available from Jennison Road in front of the house, a two-door historic residence that is very well maintained. Pasture land covered with creeping juniper across Jennison Road to the south is still used today for this purpose. The second agricultural landscape on Jennison Road exists on the north side and appears with a southern aspect and a large barn.

There are many scenic woods roads in Wendell that support recreational activities such as hiking and snowmobiling. Some of the more notable include Bear Mountain Trail, off Stone Road. Crossing this is Thompson Road, which is now more like a woods trail. It travels north from Farley Road to Old Farley Road which run along the Millers River. An old woods road off Stone Road and Wendell Depot Road provides access to a marsh. Hemmiway Road, unpaved, passes near the eastern end of the large hardwood swamp named Catamount, and continues on to Locks Village at Lake Wyola. Rockwell Hill Road, an unpaved, discontinued road off Cooleyville Road, passes through largely DCR land to New Salem. It has large hemlock and white pine with an understory of mountain laurel.

F.7 Unusual Natural Communities

F.7.1 High-Energy Riverbank and Floodplain Forest Environments on the Millers River

According to the Mass. Division of Fisheries and Wildlife, there are unusual examples of a floodplain forest and high-energy riverbank environments along the Millers River in Wendell. The floodplain forest is a silver maple dominated community. Such forests attract migratory songbirds, raptors such as bald eagles and red-shouldered hawks as well as wood ducks and hooded mergansers. The Millers River also supports a variety of wetland species such as turtles, salamanders, and freshwater mussels that are good indicators of improving conditions along the river. The high-energy riverbank environment is created by the alluvial deposition of cobbles, sand, and silt during high spring floods. Vegetation within the high-energy riverbank community depends on substrate type and the severity of flooding. On open cobbles, one will find false dragonhead, cocklebur, beggar's ticks and lady's thumb. As the sand increases, water horsetail and clasping dogbane occur. In still sandier areas, mixed grasslands are found. In the sandiest areas, which typically border the floodplain forest, short shrubs such as shadbush, silky dogwood, sand bar willow, and sand bar cherry are found. The entire section of the Millers River in Wendell is considered both a Priority Habitat of Rare Species and an Estimated Habitat of Rare Wildlife by the Natural Heritage and Endangered Species Program.

F.7.2 Kettle Hole Level Bogs

A Kettle Hole Level Bog can be found within Wendell State Forest, north of Montague Road. These bogs occur in iceblock depressions in sandy glacial outwash. The vegetation in these areas includes high bush blueberry and swamp azalea in the outer areas and rhodora in the interior moat areas. The mat areas of the bog have a mixture of tall and short shrubs that are

predominantly ericaceous (members of the Heath family). A mixture of specialized bog plants including pitcher plants and sundews grow on the hummocky sphagnum. Highly acidic standing water in the moats, without fish populations, functions as vernal pool habitat, providing important amphibian breeding sites.

F.8 Significant Historical Agricultural Landscapes

Wendell loves its old fields because they remind us of how this land was first settled by Europeans. Some of the existing old fields have been documented as *significant historical agricultural landscapes*. There are three specific agricultural landscapes that were identified in the 1992 Franklin County Rural Historic Landscape Preservation Plan: Town Common, J. Wyman Farm on Wickett Pond Road, and the J.C. Holston property on Depot Road. The protection status of the landscape surrounding the Town Common is unclear and primarily in private hands and unprotected, as are the Wyman and Holston properties. The fields around the Town Common are mostly to the north, south, and east of the Common. While old stonewalls, foundations, and a lone silo help to maintain the character of this landscape, the recent placement of a grey painted colonial style house in the field north of the Common has reduced the historical value of this scenic landscape. The J. Wyman Farm on Wickett Pond Road appears to have the original farmhouse and outbuildings and a small open and maintained field surrounded by forest and fields filled with white pine saplings and other early successional vegetation. The J. C. Holston property, c. 1871, burned down recently and its main house has been replaced with a new modern one. The Holston property is surrounded to the north with open fields. The modern built home may detract from the significance of this agricultural landscape. There are also multiple agricultural properties along Jennison Road, which are described in the scenic roads section.

G. ENVIRONMENTAL CHALLENGES

G.1 Acidification

Of thirteen streams sampled, five are classified as “acidified”, the most seriously impacted category, and seven are classified as “critical”, the next most impacted ranking. Only the Millers River does not appear to be in serious immediate danger of acidification. Two ponds in Wendell are ranked as acidified. The remaining five are critical. Chronic acidification has probably reduced the productivity of aquatic insects in all of Wendell’s ponds and streams and affects their recreational uses, especially fishing. Wendell’s streams are at the borderline of conditions that are capable of supporting trout. In fact, trout populations have shown considerable declines in Whetstone Brook and Mormon Hollow Brook. The very low alkalinity in streams and ponds makes them susceptible to flushes of acidic water, especially during heavy rains and during snowmelt. These pulses of low pH water are extremely damaging to fish eggs and young fish. Some streams in Town still support trout, but years of continued acid rain pose a threat to their future as places to fish. By affecting insects, amphibians and even soil fungi, acid rain can affect

the whole food chain. It is not known the extent to which acid rain is damaging forest growth or affecting the numbers and varieties of other forms of plant and animal life in Wendell.

G.2 Unplanned Residential Development

Although there may not be agreement as to its severity or solution, the overarching environmental problem for the Town of Wendell is the potential for future growth in the region and the negative impacts of unplanned residential development. New unbridled residential development will produce negative fiscal impacts on the municipal budget. This would be due to the costs of community services like education, being greater than the revenues that would be received through property taxes.

Some people argue that current environmental constraints, mainly related to soil characteristics, are sufficient to control development. The depth to the groundwater, depth to bedrock, and the occurrence of standing water are three characteristics that restrict where people may build. Others would point to changes in technology and regulations that have the potential for reducing those limitations on development. One example is Title 5 which prohibits development in areas that cannot produce particular conditions. According to one long-term Wendell resident and environmentalist, Title 5 actually worked to increase the number of lots that could be built in some areas, because the regulations allowed for the building of raised mounds to create the difference in elevation between the leach field and the groundwater. Additional technologies (for example neighborhood treatment plants) may become more common and may expose previously undevelopable sites to exploitation, the main rationale for our planning process.

New residential development across Town may increase the prevalence of non-point source pollution, reduce the rural character and cause a reduction in the acreage, and value of remaining, wildlife habitat. Sprawl will also increase runoff (potentially including contaminants such as road salt), decrease the amount of water available as ground water, decrease stream flow, and probably result in excess erosion. It will diminish biodiversity in first and second order streams and reduce water quality Town-wide. The solution to the problem may be a combination of zoning techniques to encourage development in ecologically suitable areas and further open space protection to keep houses away from the areas with the greatest scenic, ecological, cultural, and historical values.

Within this larger environmental concern of unplanned growth are two critical environmental issues requiring specific action. The first concerns water quality in the Millers River. Currently, the Millers River contains high levels of poly-chlorinated biphenyls (PCB's) and mercury that impair its full potential as a Class B fishable and swimmable water body. Every stream, brook, and river in Wendell continues to be threatened by non-point source pollution from acidification to sedimentation. In addition, the Mormon Hollow landfill is an issue that is receiving a lot of attention regionally and by the state, although it appears that there are long-term issues still to be resolved, including monitoring and stabilization. Continuing to work cooperatively with the Millers River Watershed Team and the Millers River Watershed Council may be an excellent way of putting stewardship ideals into action since the ultimate cleanup of the river will need to be a continuous, watershed-wide effort.

The second critical environmental issue concerns the danger of contaminating local untapped but still very important aquifers. There is a link between shallow aquifers of stratified drift, shallow wells, and local septic leach fields. Although there has not been a study directly linking the three in Wendell, contamination of groundwater supplies is a common enough occurrence to warrant the Massachusetts Department of Environmental Protection to create the Source Water Assessment Program (SWAP). Through SWAP, DEP assists communities in identifying the “above-ground” boundaries to recharge areas for their community water supplies. Recharge areas represent the lands where use regulations have the most impact at protecting a source from contamination. The Town of Wendell should increase its efforts to identify the recharge areas for its future water supplies.

G.3 Imported Pests and Invasive Species

Climate models project rising temperatures and increased precipitation in the Northeastern United States in coming years which is likely to impact local forests as well other vegetation and public health partially as a result of related impacts on pests, pathogens, and nuisance species. Periods of rapid climate change, such as we are presently experiencing, are especially favorable for rapidly reproducing species such as insects and diseases and promote conditions that can enhance the spread of problematic species. By contrast species with longer life cycles, such as trees, are inherently less well equipped to adapt to rapid climate change.

A 2008 study co-authored by 16 scientists including Wendell resident Kristina Stintson used ecological principles to predict the potential response of several pests, pathogens, and invasive species to climate change in the forests of North America. Of the six species studied the authors were most confident in their ability to predict that the Hemlock woolly adelgid, a small insect that attacks and kills Hemlocks and has been sighted at several locations in Wendell, may spread unimpeded, leading to widespread hemlock mortality.

Thus the town would be wise to take a proactive approach to environmental problems related to the spread of introduced pests, including invasive species, and stay abreast of the latest information about related problems that may impact local vegetation, agriculture, forestry wildlife, and public health, as well as related strategies for sustainable management. Such efforts will require cooperation with state and regional efforts and may involve several Town boards and departments including the open space committee, the board of health, the agricultural commission, the tree warden, and the conservation commission, as well.

G4. Landfills and Hazardous Waste Disposal Sites

Wendell has had two landfills, one public and one private, both of which are now inactive. The municipal landfill on New Salem Road was closed in 1990 and is neither capped nor lined. The private landfill on Mormon Hollow Road was used for demolition waste and is lined and partially capped after being closed in 1999. The Mormon Hollow Landfill was the subject of a release reportable to the Department of Environmental Protection (DEP) in 2000 when it was

found to be unstable and sliding down the hillside.⁹ In 2007, it was deemed by the DEP to be adequately regulated and is still being monitored.

The DEP Searchable Waste Site also lists a reportable release of hazardous materials in November 2009 of 20 gallons of hydraulic fluid on an unpaved road in the A127 transmission right of way. This site's compliance status was deemed in January 2010 to be "RAO," meaning that a Response Action Outcome statement was filed asserting that response actions were sufficient to achieve a level of no significant risk. One of the Town-owned lots by the Millers River at Wendell Depot has been identified as an apparent hazardous waste disposal site and may be a potential brownfield.

G.5 Chronic Flooding

According to members of the Open Space and Recreation Planning Committee, there are several areas of Town that are subject to chronic flooding, primarily as a result of beavers. These areas are located on Farley Road near the school, on a feeder brook into Plympton Brook that is near Lockes Village Road and the Stillwater Ponds, and in Wendell Depot where Whetstone Brook crosses Wendell Depot Road.

G.6 Erosion and Sedimentation

There are currently no problems with erosion and sedimentation in the Town of Wendell.

G.7 Regional Environmental Issues

Several regional environmental issues are of special concern to Wendell residents and officials. The potential for environmental contamination resulting from problems with the aging Vermont Yankee nuclear power plant has been a concern for decades as Wendell lies just over the border of the primary emergency response zone. In recent years, the potential environmental impacts of the proposed Greenfield biomass facility has become such an important environmental issue for Wendell that the Selectboard wrote to Governor Patrick in 2009 to raise concerns about how the project could impact the town's environment. As the Wendell State Forest covers such a large area of town, residents and local officials have a variety of concerns about the possible environmental impacts of the various management strategies that the Commonwealth is considering for the state forest as part of the Forest Futures Visioning process.

In their letter to Governor Patrick, the Wendell Selectboard cautioned about potential environmental impacts related to the use of biomass in general and the proposed Greenfield facility in particular. They reviewed the potential impacts for all citizens of the Commonwealth and surrounding states as well the direct impacts that a plant in Greenfield could have on the town. More general concerns include the release of carbon from incineration accelerating global

⁹ Department of Environmental Protection, Searchable Waste Site List:
<http://db.state.ma.us/dep/cleanup/sites/search.asp>.

warning, increased consumption of forest resources, pollution of the air with carcinogens, the health of local forests, and public health. Their letter stated that “Wendell’s air quality would decline precipitously as the Wendell State Forest is logged, and the prevailing winds bring emissions from the proposed Greenfield plant into Wendell.”

The Commonwealth’s Forest Futures Visioning process that is ongoing in 2010 has sparked concerns among Wendell residents and officials about the potential environmental impacts of the designation of the non-parkland areas of the Wendell State Forest as either reserves or woodlands. As the forest comprises such a large area of town, this designation could have significant repercussions for town and local forests. In September of 2010, residents favoring both reserve and woodlands status have raised concerns to the Selectboard about the environmental impacts of either course of action. Advocates of the reserve designation cite ecological benefits of leaving areas undisturbed for natural systems and preserving forests to buffer against climate change. Opponents of the reserve designation suggest that a lack of active management could leave the forest vulnerable to severe weather damage, forest fires, and other problems. Thus, local officials are considering hosting a public forum on the subject to further explore these potential impacts. They are also looking forward to learning about plans that the state might have to allow the town to offer more comprehensive input into this decision. (See Appendix D for statements regarding forest designations in Wendell.)